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Research Article

Refining the phylogeny and taxonomy of the apple tribe Maleae (Rosaceae): insights from phylogenomic analyses of 563 plastomes and a taxonomic synopsis of *Photinia* and its allies in the Old World

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Abstract

This study addresses the longstanding absence of a comprehensive phylogenetic backbone for the apple tribe Maleae, a deficiency attributed to limited taxon and marker sampling. We conducted an extensive taxon sampling, incorporating 563 plastomes from a diverse range of 370 species encompassing 26 presently recognized genera. Employing a range of phylogenetic inference methods, including RAxML and IQ-TREE2 for Maximum Likelihood (ML) analyses, we established a robust phylogenetic framework for the Maleae tribe. Our phylogenomic investigations provided compelling support for three major clades within Maleae. By integrating nuclear phylogenetic data with morphological and chromosomal evidence, we propose an updated infra-tribal taxonomic system, comprising subtribe Malinae Reveal, subtribe Lindleyinae Reveal, and subtribe Vauqueliniinae B.B.Liu (**subtr. nov.**). Plastid phylogenetic analysis also confirmed the monophyly of most genera, except for *Amelanchier*, *Malus*, *Sorbus* sensu lato, and *Stranvaesia*. In addition, we present a comprehensive taxonomic synopsis of *Photinia* and its morphological allies in the Old World, recognizing 27 species and ten varieties within *Photinia*, three species and two varieties within *Stranvaesia*, and two species and three varieties within *Weniomeles*. Furthermore, we also lectotypified 12 names and made two new combinations, *Photinia microphylla* (J.E.Vidal) B.B.Liu and *Weniomeles atropurpurea* (P.L.Chiu ex Z.H.Chen & X.F.Jin) B.B.Liu.

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Key words: Classification, lectotype, nomenclature, *Pourthiaea*, *Stranvaesia*, typification, *Weniomeles*

Introduction

The apple tribe Maleae, one of the sixteen tribes within the Rosaceae family, comprises approximately 27 genera and 912 species, with a widespread distribution across the Northern Hemisphere (Robertson et al. 1991; Lu et al. 2003; Phipps 2014). This tribe includes diverse genera such as *Kageneckia* Ruiz & Pav., *Lindleya* Kunth, and *Vauquelinia* Corrêa ex Bonpl., noted for their follicles and capsules, alongside pome-bearing genera previously categorized under the subfamily Maloideae (Morgan et al. 1994). The monophyly of this lineage has been confirmed by a series of phylogenetic studies (Fig. 1; Potter et al. 2007; Xiang et al. 2017; Zhang et al. 2017; Liu et al. 2020a, 2022).

As a prominent member of the nine tribes within the subfamily Amygdaloideae, the apple tribe Maleae has been consistently supported as a monophyletic group and the sister relationship to the tribe Gillenieae (Fig. 1). Within Maleae, numerous prior studies have consistently confirmed the close phylogenetic relationship between the dry-fruited genera (*Kageneckia*, *Lindleya*, and *Vauquelinia*) and the pome-bearing genera. This phylogenetic hypothesis has been corroborated by a series of studies employing a range of methods, from the utilization of singular or multiple plastid and nuclear markers (Morgan et al. 1994; Evans et al. 2000; Evans and Campbell 2002; Evans and Dickinson 2005; Verbylaitė et al. 2006; Campbell et al. 2007; Potter et al. 2007; Li et al. 2012; Lo and Donoghue 2012; Sun et al. 2018) to the most recent phylogenomic approaches (Xiang et al. 2017; Zhang et al. 2017; Liu et al. 2019, 2020a, 2022; Jin et al. 2023; Zhang et al. 2023). However, despite these endeavors, earlier phylogenetic studies were unable to resolve the intergeneric relationships within Maleae due to the limited plastid and nuclear markers. For instance, early studies by Campbell et al. (2007) and Potter et al. (2007) grouped the dry-fruited and pome-bearing genera under the tribe Pyreae (also known as Maleae). They also reclassified the pome-bearing genera (formerly known as subfamily Maloideae) into the subtribe Pyrinae (or Malinae). Despite these developments, the precise phylogenetic relationships and taxonomic status of *Kageneckia*, *Lindleya*, and *Vauquelinia* remained unresolved. Recent advancements in phylogenomics have demonstrated that datasets encompassing plastomes and/or hundreds of nuclear genes can offer sufficient informative sites for elucidating phylogenetic relationships. However, the substantial costs for genome-level sequencing have led to limited taxon sampling in contemporary phylogenomic analyses, such as the studies by Liu et al. (2022), Jin et al. (2023), and Zhang et al. (2023).

Accurately resolving its genus-level phylogenetic relationships has also remained a significant challenge. This difficulty is primarily attributed to the lack of informative genetic markers and ample taxon sampling, as highlighted in studies by Lo and Donoghue (2012) and Liu et al. (2022). During the Sanger sequencing era, Lo and Donoghue (2012) made a substantial contribution by assembling a dataset comprising 486 individuals, representing 331 species

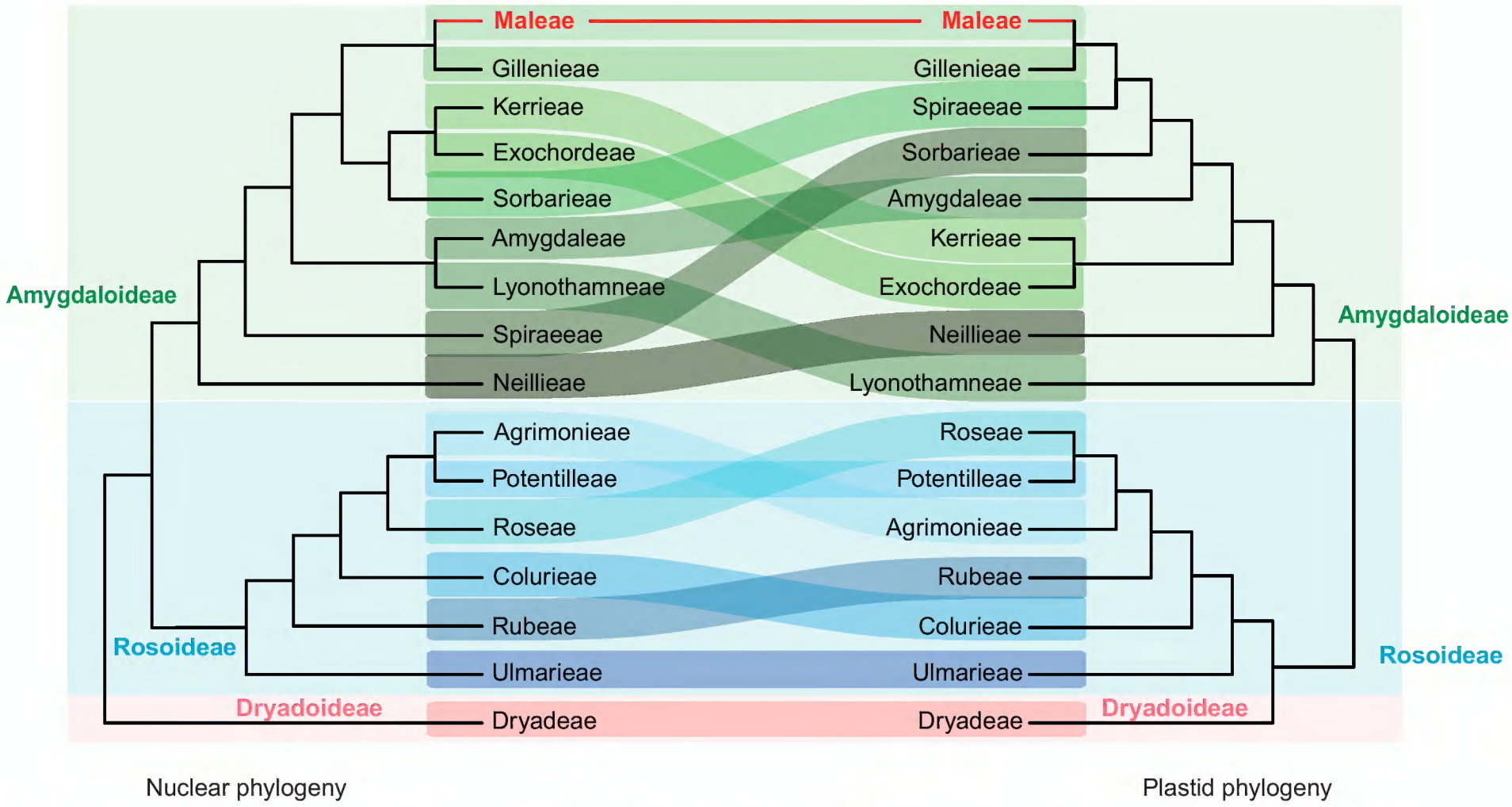


Figure 1. Infrafamilial- and tribe-level topological discordance within Rosaceae, highlighting the phylogenetic placement of the tribe Maleae **A** nuclear phylogeny based on transcriptome data (Xiang et al. 2017) **B** plastome-based phylogeny (Zhang et al. 2017).

across 27 currently recognized genera. This dataset, one of the largest of its kind, utilized 11 plastid regions and one nuclear ribosomal internal transcribed spacer (nrITS) sequence. However, advancements in genetic research have revealed that such limited informative sites from several plastid and nuclear regions are insufficient for estimating a robust phylogenetic backbone. Next-generation sequencing (NGS) technologies, combined with decreasing sequencing costs and user-friendly bioinformatics tools, have revolutionized the approach to understanding phylogenetic relationships. The transition from Sanger sequencing to NGS has allowed for deeper phylogenetic analysis. A notable example of this progress is the study of Zhang et al. (2017), who estimated a plastid framework for the Rosaceae family using 122 plastomes, including 41 species from the Maleae tribe. This study marked a significant step in our evolutionary understanding of Maleae. Following this, there has been a surge of global research efforts to elucidate the phylogenetic relationships within Maleae using plastome-level datasets. Pioneering studies by Liu et al. (2019, 2020a, 2020b, 2022), Meng et al. (2021), Ulaszewski et al. (2021), Liu et al. (2023a, 2023b), Jin et al. (2023, 2024), and Ma et al. (2023) have significantly contributed to this field. These studies have employed extensive plastome datasets, vastly improving upon previous efforts in scale and depth. However, a common limitation of these studies has been the relatively narrow focus on a few species or a specific lineage within Maleae. This has resulted in an incomplete phylogenetic picture of Maleae. More comprehensive and inclusive research is needed, as it would provide a more thorough understanding of Maleae. Such an approach would involve extensive sampling across the tribe, incorporating a wide range of species to cover the full breadth of its genetic diversity.

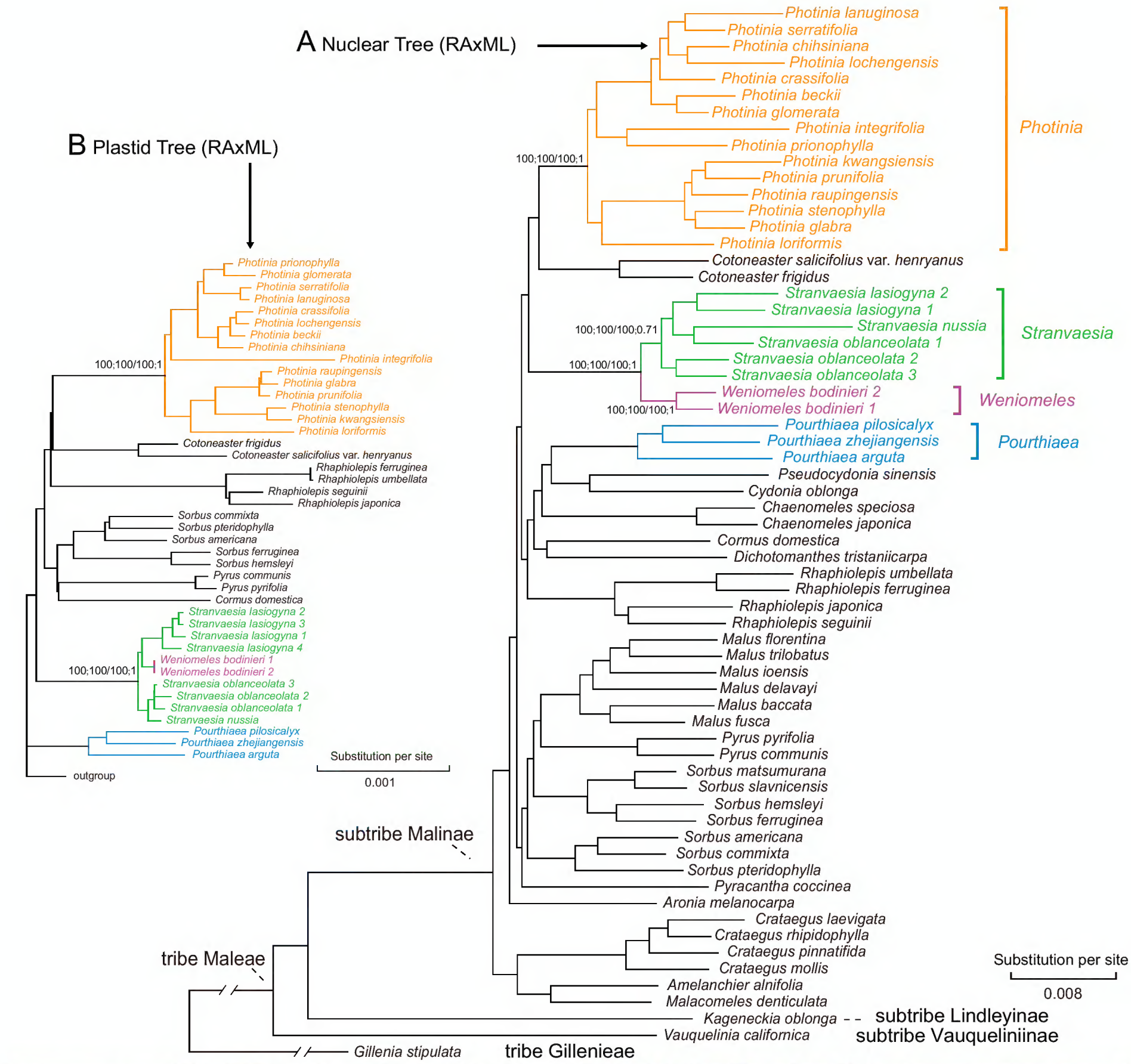
The chloroplast genome, assembled from genome skimming data (Straub et al. 2012), has played a pivotal role in plant systematics and phylogenetics (Guo et al. 2023). Its highly conserved nature and areas of variable sequences make it widely used in phylogenetic analysis (Gitzendanner et al. 2018). Furthermore, this genetic stability, along with the non-recombinant of plastomes and often uniparental inheritance, offers a consistent and reliable framework for studying plant lineage and evolution, and the plastome-based phylogenetic inference has been successfully utilized in exploring the shallow (Zhang et al. 2017; Liu et al. 2019, 2020a, 2020b; Wang et al. 2020; Su et al. 2021) and deep phylogenies (Li et al. 2019, 2021). In this study, we assembled 563 plastomes from genome skimming data to reconstruct a comprehensive plastome-based phylogenetic framework for the tribe Maleae.

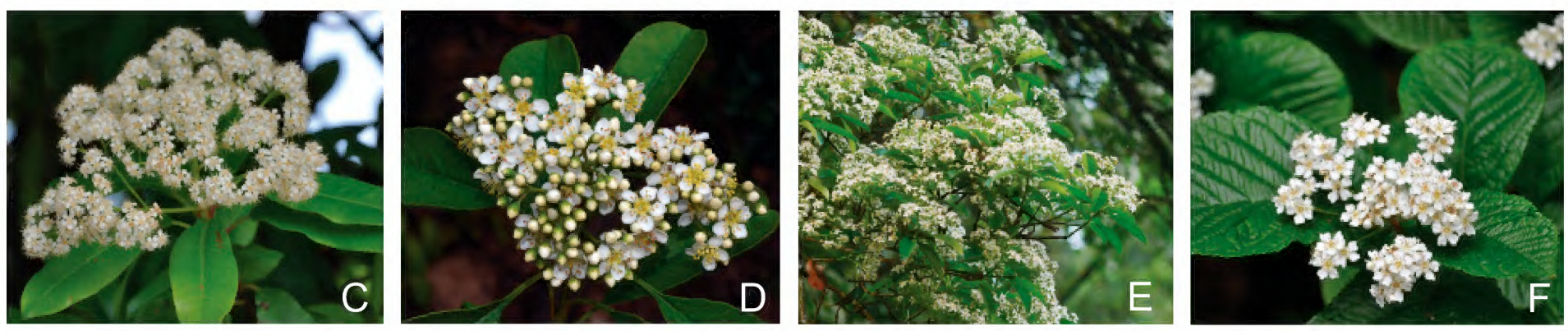
The taxonomic delimitation and phylogenetic relationship between *Photinia* Lindl. and its morphologically related genera in the Old World have been a subject of debate for centuries. In the Old World, the *Photinia*-affiliated genera comprised four groups: the deciduous genus *Pourthiaea* Decne., and the evergreen genera *Photinia*, *Stranvaesia* Lindl., and *Weniomeles* B.B.Liu. *Photinia* was initially described with a single evergreen species, *P. arbutifolia* Lindl., and later expanded to include four evergreen species (Lindley 1821). Subsequently, de Candolle (1825) incorporated two deciduous species into *Photinia*, thereby establishing the genus *Photinia*, encompassing both evergreen and deciduous species. *Photinia* has been recognized as comprising about 60 species, both evergreen and deciduous, distributed disjointedly across East and Southeast Asia, and Mexico (Rehder 1940; Vidal 1965; Yu 1974; Phipps et al. 1990; Robertson et al. 1991; Phipps 1992; Lu et al. 2003). Decaisne (1874) observed distinctive warty peduncles and pedicels on the fruits of deciduous species, setting them apart from their evergreen counterparts, leading to the establishment of these deciduous species under the newly formed genus *Pourthiaea*. This classification, recognizing *Pourthiaea* as a separate genus, gained widespread acceptance among botanists, including Nakai (1916), Ohashi (1989), Iketani and Ohashi (1991, 2001), Liu and Hong (2016a, 2016b, 2017), and Liu et al. (2023b). The separate generic status of *Pourthiaea* has also been further substantiated by recent molecular studies (Guo et al. 2011; Li et al. 2012; Zhang et al. 2017; Sun et al. 2018; Liu et al. 2019, 2022). Furthermore, Phipps (1992) revealed that the five species and three varieties of *Photinia* indigenous to Central America exhibit distinct morphological characteristics compared to the *Photinia* species from East Asia. This distinction was corroborated by phylogenomic evidence, which employed whole plastome and nuclear ribosomal DNA (nrDNA) datasets. Based on these findings, these Central American species were reclassified into a newly proposed genus, *Phippsiomeles* B.B.Liu & J.Wen, as elaborated in Liu et al. (2019).

First described by Lindley in 1837, the red-fruit genus *Stranvaesia* is a relatively small group, encompassing five species native to China, the Himalayas, and Southeast Asia (Lu et al. 2003). Morphologically similar to *Photinia*, *Stranvaesia* is distinguishable by its unique characteristics, including a four- or five-chambered ovary and dehiscent fruits. These distinct features have led to its classification as a separate genus in numerous taxonomic

studies spanning from the mid-19th to early 21st centuries (Roemer 1847; Decaisne 1874; Wenzig 1883; Focke 1888; Koehne 1893; Rehder 1940, 1949; Yu 1974; Lu et al. 2003). However, this classification was challenged by Kalkman (1973), who observed negligible differences in the number of carpels between *Stranvaesia* and *Photinia*. He noted that the supposedly dehiscent fruits of *Stranvaesia davidiana* Decne. did not exhibit dehiscence in botanical garden observations, leading to the proposal of merging *Stranvaesia* into *Photinia* due to these morphological similarities. Despite this, the relationship between these two genera has been a long-standing taxonomic puzzle, with some botanists advocating for their distinct genus status (Yu 1974; Lu et al. 2003), while others supported merging them (Lu et al. 1991; Li et al. 1992; Zhang and Baas 1992). Recent phylogenetic and phylogenomic studies have shed light on this controversy. For instance, based on two chloroplast DNA regions and nrITS sequence, Guo et al. (2011) inferred that *Photinia davidsoniae* Rehder & E.H.Wilson (= *P. bodinieri* H.Lév.) and *P. nussia* (Buch.-Ham. ex D.Don) Kalkman (= *Stranvaesia nussia* (Buch.-Ham. ex D.Don) Decne.) formed a clade with strong support; however, the phylogenetic relationship between this clade and *Photinia* has been uncertain due to the limited informative sites. Liu et al. (2019) expanded the taxon sampling in their phylogenomic study within the Maleae framework, providing strong support for a redefined *Stranvaesia* clade, including three species, *S. bodinieri* (H.Lév.) B.B.Liu & J.Wen, *S. oblanceolata* (Rehder & E.H.Wilson) Stapf, and *S. nussia* (type species). Additionally, Liu et al. (2019) identified a novel distinguishing character for *Stranvaesia* not previously used in differentiating it from *Photinia*: the presence of a cluster of sclereids forming an ellipsoid between carpels in the flesh of pomes. This discovery, alongside the robust phylogeny, led to a redefinition of the generic limits of *Stranvaesia* and several nomenclatural changes. Further molecular analysis by Guo et al. (2020) confirmed the distinct phylogenetic placement of *Stranvaesia* and introduced another distinguishing trait: the unarmed branches of young trees. Despite this progress, ongoing uncertainties in the generic delimitation of *Photinia* and *Stranvaesia* persist due to factors like insufficient sampling (Liu et al. 2019) and limited informative sites (Guo et al. 2011, 2020). The complexity is compounded by polyploidy and hybridization-driven lineages, which challenge traditional taxonomic treatments. Jin et al. (2023) provided further insights, suggesting that the origin of the redefined genus *Stranvaesia* may involve allopolyploidy and introgression, with the most recent common ancestor (MRCA) of *Stranvaesia bodinieri* likely acting as the maternal parent and an extinct lineage as the paternal parent. Consequently, *Stranvaesia bodinieri* was proposed as a new genus, *Weniomeles*, characterized by purple-black fruits, thorny trunks and/or branches, and a fruit core with multiloculars separated by a sclereid layer and a sclereid cluster at the top of the locules (Fig. 2A).

Our study focuses on three key goals: 1) to establish a robustly plastome-based phylogenetic backbone for the apple tribe Maleae, 2) to update and refine the infra-tribal taxonomic system within Maleae, and 3) to compile a detailed taxonomic synopsis of *Photinia* and its closely related groups in the Old World.





Photinia serratifolia *Stranvaesia lasiogyna* *Weniomeles bodinieri* *Pourthiaea magnoliifolia*

Figure 2. Phylogenetic tree of the apple tribe Maleae estimated by Maximum Likelihood (ML) algorithm using RAxML, based on a concatenated 426 single-copy nuclear genes (SCN genes) supermatrix **A** inset in the upper left corner **B** a segment of the RAxML tree focusing on *Photinia* and its allies, inferred from concatenated 78 plastid coding sequences (plastid CDSs). (Adapted from Jin et al. (2023)) **C** *Photinia serratifolia* (Zhejiang, China: Bin-Bin Liu) **D** *Stranvaesia lasiogyna* (Yunnan, China: Bin-Bin Liu) **E** *Weniomeles bodinieri* (Yunnan, China: Bin-Bin Liu) **F** *Pourthiaea magnoliifolia* (Zhejiang, China: Bin-Bin Liu).

Materials and methods

Taxon sampling, DNA extraction, and sequencing

In this study, we compiled 563 plastomes to estimate a plastid framework for the apple tribe Maleae. This collection encompasses 559 individuals within Maleae, representing almost all genera except for the Madeira endemic genus, *Chamaemeles* Lindl. We employed *Gillenia* Moench, comprising two species from four individuals, as the outgroup. Our dataset included 559 ingroup samples, covering a wide spectrum of species diversity across various genera: 14 out of 24 species in *Amelanchier* Medik. (14 individuals), all two species in *Aronia* Medik. (two individuals), all four species in *Chaenomeles* Lindl. (seven individuals), 63 taxa (53 species, eight varieties, one subspecies) out of 261 species in *Cotoneaster* Medik. (66 individuals), 20 out of 222 species in *Crataegus* L. (33 individuals), one species for the monotypic genus *Cydonia* Mill. (two individuals), one species for the monotypic genus *Dichotomanthes* Kurz (two individuals), six out of 11 species in *Hesperomeles* Lindl. (six individuals), one species for the monotypic genus *Heteromeles* M.Roem. (two individuals), all four species in *Kageneckia* Ruiz & Pav. (four individuals), one species for the monotypic genus *Lindleya* Kunth (one individual), one out of five species in *Malacomeles* (Decne.) Decne. (two individuals), three species in *Osteomeles* Lindl. (three individuals), one species for the monotypic genus *Peraphyllum* Nutt. (two individuals), three out of five species in *Phippsiomeles* (three individuals), 20 out of 27 species in *Photinia* (31 individuals), 14 species in *Pourthiaea* (53 individuals), one species for the monotypic genus *Pseudocydonia* (C.K.Schneid.) C.K.Schneid. (three individuals), three species in *Pyracantha* M.Roem. (five individuals), 17 out of 83 species in *Pyrus* L. (26 individuals), 30 out of 42 species in *Rhaphiolepis* Lindl. (40 individuals), all three species in *Stranvaesia* (three individuals), five species in *Vauquelinia* Corrêa ex Bonpl. (five individuals), and one species in *Weniomeles* (three individuals). Notably, we sampled 46 species and five cultivars in *Malus* Mill. (94 individuals) and 99 species out of 160 in *Sorbus* L. sensu lato (142 individuals), encompassing subgroups like *Aria* (Pers.) Host, *Chamaemespilus* Medik., *Cormus* Spach, *Micromeles* Decne., *Torminalis* Medik., and *Sorbus* sensu stricto. This comprehensive survey thus provides a significant insight into the plastid diversity of the Maleae tribe, covering a broad range of species and varieties across its numerous genera (Table 1).

Total genomic DNAs were extracted from silica-gel dried leaves and herbarium specimens using a modified cetyltrimethylammonium bromide (CTAB) method, as described by Li et al. (2013). This extraction was performed at the State Key Laboratory of Plant Diversity and Specialty Crops, Institute of Botany, Chinese Academy of Science (IBCAS) in China. The subsequent library preparation and sequencing processes were conducted at the Novogene laboratory in Beijing, utilizing the NEBNext® Ultra™ II DNA Library Prep Kit, designed specifically for the Illumina® platform. We generated paired-end reads of 150 bp using the Illumina HiSeq 2500 Instrument (Novogene Beijing). This approach ensured high-quality DNA sequencing, which is important for our research objectives.

Table 1. Accessions of the apple tribe Maleae utilized in this study. The rows highlighted in bold indicate that samples were sequenced by our PhyloAI team at the Institute of Botany, Chinese Academy of Sciences. Additionally, asterisks (*) appended to the accession numbers denote that these plastomes were sequenced for this study. Plastomes lacking locality and voucher information were retrieved from GenBank.

Species name	Accession number	Locality	Voucher
Amelanchier alnifolia (Nutt.) Nutt. ex M.Roem.	MN068255	-	-
Amelanchier arborea (F.Michx.) Fernald	MN068254	-	-
Amelanchier asiatica Endl.	MN068253	-	-
***Amelanchier bartramiana* (Tausch) M.Roem.**	**MN068256**	**Terrae-Novae, Canada**	***E. Rouleau 3959* (US2421653)**
***Amelanchier cusickii* Fernald**	**MN068257**	**Washington, USA**	***J. William & Thompson 14588* (US1889072)**
***Amelanchier fernaldii* Wiegand**	**MN068258**	**Quebec, Canada**	***F. Marie-Victorin & F. Rolland-Germain 27898* (US1435540)**
***Amelanchier humilis* Wiegand**	**MN068259**	**North Dakota, USA**	***O.A. Stevens 1424* (US2134929)**
***Amelanchier interior* E.L.Nielsen**	**MN068260**	**Iowa, USA**	***R.F. Thorne 12413* (US2230661)**
Amelanchier obovalis (Michx.) Ashe	MK920296	-	-
Amelanchier ovalis Medik.	MK920297	-	-
***Amelanchier pallida* Greene**	**MN068261**	**Baja California, Mexico**	***R.E. Broder 737* (US2412566)**
***Amelanchier sanguinea* (Pursh) DC.**	**MN068262**	**Quebec, Canada**	***J. Wen 10472* (US01176270)**
***Amelanchier sinica* Chun**	**MK920291**	**Beijing, China**	***B.B. Liu & G.N. Liu 220725* (PE)**
***Amelanchier spicata* (Lam.) K.Koch**	**MK920292**	**Washington DC, USA**	***J. Wen 12951* (US)**
***Aronia arbutifolia* (L.) Pers.**	**MN061996**	**Rhode Island, USA**	***J. Wen 13937* (US)**
Aronia melanocarpa (Michx.) Elliott	MT527725	-	-
Chaenomeles cathayensis C.K.Schneid. 1	MT561270	-	-
***Chaenomeles cathayensis* 2**	**MN061997**	**Beijing, China**	***B.B. Liu et al. 3909* (PE)**
***Chaenomeles japonica* (Thunb.) Lindl. ex Spach 1**	**MZ984211**	**Beijing, China**	***B.B. Liu & G.N. Liu 3926* (PE)**
Chaenomeles japonica 2	KT932966	-	-
***Chaenomeles speciosa* (Sweet) Nakai 1**	**MZ984212**	**Beijing, China**	***B.B. Liu 3985* (PE)**
Chaenomeles speciosa 2	MT937182	-	-
Chaenomeles thibetica T.T.Yu	MT561271	-	-
***Cotoneaster acuminatus* Lindl.**	**MN577874**	**Tibet, China**	***PE Tibet Team PE6623* (PE)**
Cotoneaster acutifolius var. *villosulus* Rehder & E.H.Wilson	MK650048	-	-
Cotoneaster adpressus Bois	OQ992642	-	-
Cotoneaster adpressus var. *praecox* Bois & P.Berthault	MK638986	-	-
Cotoneaster affinis Lindl.	MK650051	-	-
Cotoneaster argenteus G.Klotz	MK578683	-	-
Cotoneaster astrophoros J.Fryer & E.C.Nelson	MK650065	-	-
Cotoneaster bullatus Bois	MK614791	-	-
***Cotoneaster buxifolius* Wall. ex Lindl.**	**MN577892**	**Sichuan, China**	***B.B. Liu 2666* (PE)**
Cotoneaster buxifolius var. *vellaeus* (Franch.) G.Klotz	MK614795	-	-
Cotoneaster conspicuus C.Marquand	MK650062	-	-
Cotoneaster coriaceus Franch.	MK650049	-	-
Cotoneaster dammeri C.K.Schneid.	MK650059	-	-

Species name	Accession number	Locality	Voucher
Cotoneaster dammeri subsp. *songmingensis* C.Y.Wu & Li H.Zhou	MK605511	-	-
Cotoneaster delavayanus G.Klotz	MK605518	-	-
Cotoneaster dielsianus E.Pritz. ex Diels	MK614800	-	-
Cotoneaster foveolatus Rehder & E.H.Wilson	MK650046	-	-
Cotoneaster franchetii Bois 1	MK650050	-	-
Cotoneaster franchetii 2	KY419994	-	-
Cotoneaster franchetii var. *cinerascens* Rehder	MK638991	-	-
Cotoneaster frigidus Wall.	MN577875	-	-
Cotoneaster gamblei G.Klotz	MK650052	-	-
Cotoneaster glaucophyllus var. *serotinus* (Hutch.) L.T.Lu & Brach	MK578685	-	-
Cotoneaster hebephyllus Diels	MK638988	-	-
Cotoneaster hebephyllus var. *fulvidus* W.W.Sm.	MK614792	-	-
Cotoneaster horizontalis Decne.	MN577893	-	-
Cotoneaster huahongdongensis J.Fryer & B.Hylmö	MK614796	-	-
Cotoneaster insolitus G.Klotz	OP494721	-	-
Cotoneaster integerrimus Medik.	MK614799	-	-
Cotoneaster langei G.Klotz	MK605516	-	-
Cotoneaster leveillei J.Fryer & B.Hylmö	MK544857	-	-
Cotoneaster marginatus Hort. ex K.Koch	MK605510	-	-
Cotoneaster melanocarpus Fisch. ex Blytt	MK561977	-	-
***Cotoneaster microphyllus* Wall. ex Lindl.**	**MN577873**	**Tibet, China**	***PE Tibet Team PE5890* (PE)**
Cotoneaster microphyllus var. *cochleatus* (Franch.) Rehder & E.H.Wilson	MK524400	-	-
Cotoneaster microphyllus var. *microphyllus* Wall. ex Lindl.	MK544856	-	-
Cotoneaster mongolicus Pojark.	MZ475330	-	-
Cotoneaster moupinensis Franch.	MK614797	-	-
Cotoneaster multiflorus Bunge	OQ992643	-	-
Cotoneaster obscurus Rehder & E.H.Wilson	MK614798	-	-
Cotoneaster pannosus Franch.	MK605509	-	-
Cotoneaster perpusillus (C.K.Schneid.) Flinck & B.Hylmö	MK638994	-	-
Cotoneaster qungbixiensis J.Fryer & B.Hylmö	MK605513	-	-
Cotoneaster reticulatus Rehder & E.H.Wilson	MK650055	-	-
Cotoneaster rockii G.Klotz	MK605515	-	-
Cotoneaster rosiflorus Kun C.Chang & F.Y.Lu	OP800435	-	-
Cotoneaster rotundifolius Wall. ex Lindl.	MK650063	-	-
Cotoneaster rubens W.W.Sm.	MN577895	-	-
Cotoneaster salicifolius Franch. 1	KY419943	-	-
Cotoneaster salicifolius 2	MK638989	-	-
Cotoneaster salicifolius var. *henryanus* (C.K.Schneid.) T.T.Yu	MN577863	-	-
Cotoneaster schantungensis G.Klotz 1	MK650053	-	-
Cotoneaster schantungensis 2	MN457692	-	-

Species name	Accession number	Locality	Voucher
Cotoneaster shansiensis J.Fryer & B.Hylmö	MK650064	-	-
Cotoneaster sherriffii G.Klotz	MK614794	-	-
Cotoneaster silvestrii Pamp.	MN577894	-	-
Cotoneaster subadpressus T.T.Yu	MK650058	-	-
***Cotoneaster submultiflorus* Popov**	**MK920286**	**Tibet, China**	***PE Xizang Expedition 7046* (PE)**
Cotoneaster taylorii T.T.Yu	MN577872	-	-
Cotoneaster tenuipes Rehder & E.H.Wilson	MK650047	-	-
Cotoneaster turbinatus Craib	MK650054	-	-
Cotoneaster vandelaarii J.Fryer & B.Hylmö	MK544858	-	-
Cotoneaster verruculosus Diels	MK605512	-	-
Cotoneaster wardii W.W.Sm.	OQ992644	-	-
Cotoneaster wilsonii Nakai	MN516695	-	-
Cotoneaster zabelii C.K.Schneid.	MK650056	-	-
Crataegus × *canescens* (J.B.Phipps) T.A.Dickinson & E.Y.Y.Lo	KY420022	-	-
***Crataegus altaica* (Loudon) Lange 1**	**OR915923***	**Xinjiang, China**	***Z.M. Zhang 263* (PE01153350)**
***Crataegus altaica* 2**	**OR915924***	**Xinjiang, China**	***D.Y. Hong et al. 0136* (PE01153341)**
***Crataegus aurantia* Pojark.**	**OR897856***	**Gansu, China**	***X.G. Sun et al. 2708* (PE01841632)**
Crataegus bretschneideri C.K.Schneid.	MW963339	-	-
Crataegus chungtienensis W.W.Sm. 1	ON032469	-	-
Crataegus chungtienensis 2	KY419947	-	-
***Crataegus cuneata* Siebold & Zucc. 1**	**OR915925***	**Hubei, China**	***C.M. Zhao et al. EX2548* (PE01857312)**
Crataegus cuneata 2	MZ504723	-	-
Crataegus germanica (L.) Kuntze	MK920295	-	-
***Crataegus hupehensis* Sarg. 1**	**OR915900***	**Hubei, China**	***B.B. Liu 2322* (PE02070251)**
Crataegus hupehensis 2	MW201730	-	-
Crataegus kansuensis 1 E.H.Wilson	MF784433	-	-
***Crataegus kansuensis* 2**	**OR915910***	**Shanxi, China**	***D.M. Kong k0229* (PE02039638)**
Crataegus laevigata (Poir.) DC.	OM232780	-	-
Crataegus marshallii Eggl.	MK920293	-	-
Crataegus maximowiczii C.K.Schneid. 1	MZ494512	-	-
***Crataegus maximowiczii* 2**	**OR915918***	**Jilin, China**	***B.B. Liu et al. 4499* (PE)**
Crataegus mollis (Torr. & A.Gray) Scheele	OM232779	-	-
Crataegus monogyna Jacq.	ON641281	-	-
Crataegus oresbia W.W.Sm.	ON032470	-	-
Crataegus pinnatifida var. *major* N.E.Br. 1	KY419945	-	-
Crataegus pinnatifida var. *major* 2	MZ494513	-	-
Crataegus rhipidophylla Gand.	OM232778	-	-
***Crataegus sanguinea* Schrad.**	**OR915926***	**Innermongolia, China**	***Chifeng Collection Team 2-Z29* (PE02044283)**
***Crataegus scabrifolia* (Franch.) Rehder 1**	**OR915928***	**Yunnan, China**	***Y.L. Shui et al. 64833* (PE01438422)**
***Crataegus scabrifolia* 2**	**OR915927***	**Yunnan, China**	***G.P. Yang 333* (PE01438424)**
Crataegus scabrifolia 3	OP021659	-	-
***Crataegus songarica* 1 K.Koch**	**OR915930***	**Xinjiang, China**	***Z.M. Zhang 222* (PE01153664)**
***Crataegus songarica* 2**	**OR915929***	**Xinjiang, China**	***Y.R. Lin 74898* (PE01153668)**

Species name	Accession number	Locality	Voucher
***Crataegus marshallii* Eggl.**	**MK920294**	**Minnesota, USA**	***J. Wen 14051* (US)**
***Crataegus wilsonii* Sarg. 1**	**OR915931***	**Sichuan, China**	***Bashan Collection Team 4974* (PE01872493)**
***Crataegus wilsonii* 2**	**OR915932***	**Sichuan, China**	***Bashan Collection Team 5683* (PE01872495)**
Cydonia oblonga Mill. 1	KX499857	-	-
***Cydonia oblonga* 2**	**MN061993**	**Beijing, China**	***B.B. Liu et al. 3873* (PE)**
***Dichotomanthes tristaniicarpa* Kurz 1**	**MN577869**	**Yunnan, China**	***B.B. Liu P1921-7* (PE02070692)**
Dichotomanthes tristaniicarpa 2	KY420031	-	-
***Gillenia stipulata* (Muhl. ex Willd.) Nutt. 1**	**MN068263**	**Kentucky, USA**	***J. Watson 205* (US03694390)**
Gillenia stipulata 2	KY419996	-	-
***Gillenia trifoliata* (L.) Moench 1**	**MN068252**	**Washington DC, USA**	***B.B. Liu 4677* (US)**
Gillenia trifoliata 2	MK905738	-	-
***Hesperomeles cuneata* Lindl.**	**MN068270**	**La Paz, Bolivia**	***V.A. Funk & N. Bernal 11319* (US03695851)**
Hesperomeles ferruginea Lindl.	MN068272	-	-
***Hesperomeles glabrata* M.Roem.**	**MK920298**	**Wisconsin, USA**	***P.E. Berry 4561* (US03695884)**
Hesperomeles goudotiana Killip	MN068271	-	-
Hesperomeles obovata (Pittier) Standl.	MK920299	-	-
Hesperomeles pernettyoides Wedd.	MN068273	-	-
***Heteromeles arbutifolia* (Lindl.) M.Roem. 1**	**MK920281**	**California, USA**	***J. Wen 13512* (US)**
Heteromeles arbutifolia 2	KY419965	-	-
Kageneckia angustifolia D.Don	MN068264	-	-
Kageneckia crataegifolia Lindl.	KY420027	-	-
***Kageneckia lanceolata* Ruiz & Pav.**	**MN068265**	**Loayza, Bolivia**	***P.M. Peterson et al. s.n.* (US03694560)**
***Kageneckia oblonga* Ruiz & Pav.**	**MN068266**	**Maule, Chile**	***M. Mahu & C.H. Badilla 10358* (US03694604)**
***Lindleya mespiloides* Kunth**	**MN068248**	**Nuevo León, Mexico**	***G.B. Hinton et al. 18696* (US00903453)**
Malacomeles denticulata (Kunth) G.N.Jones 1	KY419982	-	-
***Malacomeles denticulata* 2**	**MN068267**	**Mexico**	***A. Ventura 3359* (US03513083)**
***Malus* × *atrosanguinea* (Späth) C.K.Schneid.**	**MN061983**	**Washington DC, USA**	***J. Wen 12947* (US)**
***Malus* × *magdeburgensis* Schoch ex Rehder**	**OR897858***	**USA**	***Z.L. Yan 1039* (PE01656311)**
***Malus angustifolia* (Aiton) Michx.**	**MN061984**	**Washington DC, USA**	***W.J. Kress 06-8218* (US00868046)**
Malus asiatica Nakai	MW115593	-	-
Malus baccata (L.) Borkh. 1	KX499859	-	-
***Malus baccata* 2**	**MK896774**	**Minnesota, USA**	***J. Wen 14050* (US)**
Malus baccata var. *gracilis* (Rehder) T.C.Ku	OQ737737	-	-
Malus baccata var. *xiaojinensis* (M.H.Cheng & N.G.Jiang) Ponomar. 1	MK434915	-	-
Malus baccata var. *xiaojinensis* 2	OM232782	-	-
***Malus bhutanica* (W.W.Sm.) J.B.Phipps**	**OR897828***	**Shanxi, China**	***T.Y. Le 5728* (PE00927493)**
***Malus coronaria* (L.) Mill. 1**	**OR915988***	**Ohio, USA**	***E.C. Leonard 17256* (US03696777)**
***Malus coronaria* 2**	**OR897841***	**USA**	***Z.L. Yan 1067* (PE01656272)**
***Malus coronaria* 3**	**OR897840***	**USA**	***D.E. Boufford et al. 22098* (PE01656271)**
***Malus coronaria* 4**	**OR915989***	**Virginia, USA**	***F.R. Fosberg 39620* (US03696787)**
***Malus dawsoniana* Rehder**	**OR897842***	**USA**	***Z.L. Yan 1109* (PE01656287)**

Species name	Accession number	Locality	Voucher
Malus delavayi **(Franch.) B.B.Liu**	**MN216025**	**Yunnan, China**	***B.B. Liu & F. Zhao 3959*** **(PE)**
Malus domestica **(Suckow) Borkh. 1**	**OR897843***	**Hebei, China**	***T.T. Yu 145*** **(PE01461229)**
Malus domestica 2	MW115599	-	-
Malus domestica 3	MK434916	-	-
Malus domestica **4**	**OR885573***	**Maryland, USA**	***W.J. Kress et al. 06-8136*** **(US00868210)**
Malus domestica 5	MH595623	-	-
Malus domestica 6	LT996898	-	-
Malus doumeri A.Chev. 1	KX499861	-	-
Malus doumeri 2	MN577878	-	-
Malus florentina C.K.Schneid. 1	KX499856	-	-
Malus florentina 2	KX499862	-	-
Malus floribunda Siebold ex Van Houtte 1	MW115607	-	-
Malus floribunda **2**	**OR885571***	**Beijing, China**	***B.B. Liu et al. 3941*** **(PE)**
Malus floribunda **3**	**OR885577***	**England**	***T.T. Yu s.n.*** **(PE01656286)**
Malus fusca (Raf.) C.K.Schneid. 1	MW115592	-	-
Malus fusca **2**	**OR897844***	**USA**	***Z.L. Yan 1032*** **(PE01656291)**
Malus halliana Koehne 1	MT246302	-	-
Malus halliana **2**	**OR885572***	**Innermongolia, China**	***Y.S. Chen et al. 140606*** **(PE02036839)**
Malus honanensis **Rehder 1**	**OR885580***	**Hebei, China**	***Wu 227*** **(PE01236726)**
Malus honanensis 2	MW115594	-	-
Malus hupehensis **(Pamp.) Rehder 1**	**OR885568***	**Hubei, China**	***B.B. Liu 2076*** **(PE02071835)**
Malus hupehensis 2	MK020147	-	-
Malus hupehensis **3**	**OR897845***	**Guizhou, China**	***H. Mo 6117*** **(PE00952317)**
Malus indica **(Wall.) B.B.Liu 1**	**OR897857***	**Chin State, Myanmar**	***P. Srisanga et al. 97079*** **(US03696266)**
Malus indica 2	MN088849	-	-
Malus ioensis (Alph.Wood) Britton 1	MN062004	-	-
Malus ioensis **2**	**OR915992***	**Wisconsin, USA**	***T.G. Hartley 1301*** **(US03696969)**
Malus ioensis **3**	**OR915993***	**Missouri, USA**	***E.J. Palmer 43794*** **(US03696964)**
Malus kansuensis **(Batalin) C.K.Schneid. 1**	**MZ984209**	**Hubei, China**	***B.B. Liu 2278*** **(PE)**
Malus kansuensis 2	MW018863	-	-
Malus leiocalyca **S.Z.Huang**	**OR897846***	**Fujian, China**	***236-6 Team 752*** **(PE00952788)**
Malus longiunguis (Q.Luo & J.L.Liu) B.B.Liu	MW367027	-	-
Malus mandshurica **(Maxim.) Kom. ex Skvortsov 1**	**MZ984214**	**Tibet, China**	***FLPH Tibet Expedition 12-2086*** **(PE)**
Malus mandshurica **2**	**OR885579***	**Zhejiang, China**	***T. Wang hzbg0220*** **(PE)**
Malus mandshurica 3	MW115596	-	-
Malus melliana (Hand.-Mazz.) Rehder	MW115597	-	-
Malus micromalus Makino 1	MF062434	-	-
Malus micromalus **2**	**OR915902***	**Beijing, China**	***B.B. Liu et al. 3882*** **(PE)**
Malus muliensis **T.C.Ku**	**OR897847***	**Sichuan, China**	***s.coll. s.n.*** **(PE)**
Malus ombrophila **Hand.-Mazz. 1**	**MZ984213**	**Tibet, China**	***Y.S. Chen et al. 13-1130*** **(PE)**
Malus ombrophila 2	MW115598	-	-
Malus orientalis Uglitzk.	OM232788	-	-
Malus orthocarpa **Lavalle**	**OR897848***	**Beijing, China**	***s.coll. s.n.*** **(PE)**

Species name	Accession number	Locality	Voucher
***Malus platycarpa* Rehder**	**OR897849***	**USA**	***Z.L. Yan 1051* (PE01656326)**
Malus prattii (Hemsl.) C.K.Schneid.	MH929090	-	-
Malus prunifolia (Willd.) Borkh. 1	KU851961	-	-
***Malus prunifolia* 2**	**OR915903***	**Beijing, China**	***B.B. Liu 3968* (PE)**
***Malus* × *purpurea* (Eug.Barbier) Rehder**	**OR897850***	**Beijing, China**	***s.coll. s.n.* (PE)**
***Malus robusta* Rehder 1**	**OR885575***	**Liaoniing, China**	***J.H. Sun s.n.* (PE)**
Malus robusta 2	MW115602	-	-
***Malus rockii* Rehder 1**	**OR897851***	**Yunnan, China**	***C. Xu et al. 44* (PE)**
Malus rockii 2	MW115600	-	-
***Malus sargentii* Rehder 1**	**OR885576***	**Beijing, China**	***B.B. Liu 3920* (PE)**
Malus sargentii 2	MW115605	-	-
***Malus sieboldii* Rehder 1**	**MZ984210**	**Shandong, China**	***B.B. Liu P1995-4* (PE)**
Malus sieboldii 2	MT268884	-	-
Malus sieboldii 3	MT593044	-	-
***Malus sieversii* M.Roem. 1**	**MN061985**	**Xinjiang, China**	***X.X. Zhou s.n.* (PE)**
Malus sieversii 2	MH890570	-	-
Malus sieversii var. *turkmenorum* (Juz. & Popov) Ponomar.	MW018864	-	-
***Malus sikkimensis* (Wenz.) Koehne 1**	**MZ984215**	**Tibet, China**	***PE Tibet Team PE6293* (PE)**
Malus sikkimensis 2	MW115603	-	-
***Malus sikkimensis* 3**	**OR885578***	**Beijing, China**	***Y.L. Liu 29* (PE)**
***Malus spectabilis* Borkh. 1**	**OR885570***	**Beijing, China**	***B.B. Liu et al. 3900* (PE)**
Malus spectabilis 2	MT501657	-	-
Malus sylvestris (L.) Mill. 1	MK434921	-	-
Malus sylvestris 2	LS398109	-	-
***Malus sylvestris* 3**	**OR885569***	**Silesia: Breslau, Germany**	***C. Baenitz s.n.* (US03697121)**
Malus sylvestris 4	MK434924	-	-
***Malus toringo* K.Koch**	**OR885574***	**Surisan, South Korea**	***H.J. Jung s.n.* (PE01656258)**
Malus toringoides (Rehder) Hughes 1	MT483999	-	-
Malus toringoides 2	MT442040	-	-
Malus transitoria C.K.Schneid.	MK098838	-	-
Malus trilobata C.K.Schneid.	KX499858	-	-
Malus tschonoskii (Maxim.) C.K.Schneid. 1	KX499864	-	-
Malus tschonoskii 2	KX499863	-	-
Malus yunnanensis C.K.Schneid. 1	MH394388	-	-
Malus yunnanensis 2	MH394387	-	-
Malus zhaojiaoensis N.G.Jiang	OM793283	-	-
Osteomeles anthyllidifolia Lindl.	KY419940	-	-
***Osteomeles schwerinae* C.K.Schneid.**	**MN062000**	**Gansu, China**	***D.Y. Hong et al. 3429* (PE)**
Osteomeles subrotunda K.Koch	MK977586	-	-
***Peraphyllum ramosissimum* Nutt. 1**	**KY420011**	**Nevada, USA**	***B. Maguire & A.H. Holmbren 25288* (US03513221)**
***Peraphyllum ramosissimum* 2**	**MN068268**	**Mexico**	***J.B. Phipps & P.G. Smith 5865* (US00909013)**

Species name	Accession number	Locality	Voucher
Phippsiomeles matudae **(Lundell) B.B.Liu & J.Wen**	**MN062002**	**Jalisco, Mexico**	***R. Mevaugh 13607*** **(US00909015)**
Phippsiomeles mexicana **(Baill.) B.B.Liu & J.Wen**	**MN062003**	**Michoacán, Mexico**	***T.R. Soderstron 4693*** **(US00909034)**
Phippsiomeles microcarpa subsp. *hintonii* (J.B.Phipps) B.B.Liu & J.Wen	MN062001	-	-
Photinia × *fraseri* Dress	MZ128520	-	-
Photinia beckii **C.K.Schneid. 1**	**OP021702**	**Yunnan, China**	***L.Y. Wang et al. 1625*** **(SYS)**
Photinia beckii 2	MN577889	-	-
Photinia chihsiniana **K.C.Kuan**	**OP021703**	**Guangxi, China**	***L.Y. Wang et al. 1540*** **(SYS)**
Photinia crassifolia H.Lév.	MZ984217	-	-
Photinia davidiana Cardot	KY420003	-	-
Photinia glabra **(Thunb.) Poit. 1**	**MK920277**	**Guangxi, China**	***B.B. Liu P1901-2*** **(PE02071209)**
Photinia glabra 2	MZ984218	-	-
Photinia glomerata **Rehder & E.H.Wilson 1**	**OP021704**	**Yunnan, China**	***L.Y. Wang 1666*** **(SYS)**
Photinia glomerata **2**	**OR915979***	**China**	***J. Wen 14605*** **(US)**
Photinia glomerata 3	OM772659	-	-
Photinia integrifolia **Lindl. 1**	**OP021705**	**Yunnan, China**	***L.Y. Wang et al. 1598*** **(SYS)**
Photinia integrifolia 2	MN577879	-	-
Photinia kwangsiensis **H.L.Li**	**OP021706**	**Guangxi, China**	***L.Y. Wang et al. 1719*** **(SYS)**
Photinia lanuginosa **T.T.Yu 1**	**OR915933***	**Hunan, China**	***L.B. Luo 720*** **(PE01498455)**
Photinia lanuginosa 2	MN577890	-	-
Photinia lochengensis **T.T.Yu**	**MN577888**	**Guangxi, China**	***G.R. Long 89009*** **(PE01498456)**
Photinia loriformis **W.W.Sm**	**OP021707**	**Yunnan, China**	***L.Y. Wang 1671*** **(SYS)**
Photinia prionophylla C.K.Schneid. 1	KY419946	-	-
Photinia prionophylla **2**	**MN577891**	**Yunnan, China**	***Z.D. Fang 20-427*** **(PE01498397)**
Photinia prunifolia **(Hook. & Arn.) Lindl. 1**	**OP021708**	**Zhejiang, China**	***B.B. Liu et al. 3233*** **(PE02108424)**
Photinia prunifolia **2**	**OR915934***	**Hainan, China**	***X.X. Zhou 376*** **(PE)**
Photinia pustulata **Lindl.**	**OR149024**	**Lam Dong, Vietnam**	***J. Wen 11063*** **(US00863110)**
Photinia raupingensis **K.C.Kuan 1**	**OP021709**	**Guangdong, China**	***L.Y. Wang 1788*** **(SYS)**
Photinia raupingensis **2**	**MK920279**	**Guangdong, China**	***X.X. Zhou BOP217164*** **(PE)**
Photinia serratifolia **(Desf.) Kalkman 1**	**OP021710**	**Zhejiang, China**	***B.B. Liu et al. 2887*** **(PE02108425)**
Photinia serratifolia **2**	**MN577865**	**Fujian, China**	***B.B. Liu 2408*** **(PE)**
Photinia sp.	MT230547	-	-
Photinia stenophylla **Hand.-Mazz.**	**OP021711**	**Guizhou, China**	***L.Y. Wang 1648*** **(SYS)**
Photinia taishunensis **G.H.Xia, L.H.Lou & S.H.Jin**	**MK920278**	**Zhejiang, China**	***B.B. Liu P1950-5*** **(PE)**
Photinia undulata Cardot	MZ562937	-	-
Pourthiaea amphidoxa **(C.K.Schneid.) Stapf 1**	**MT249042**	**Hubei, China**	***B.B. Liu 2072*** **(PE)**
Pourthiaea amphidoxa **2**	**MN061992**	**Sichuan, China**	***L. Xie SC2014013*** **(PE02050150)**
Pourthiaea amphidoxa **3**	**MT249049**	**Sichuan, China**	***W.B. Ju et al. HGX12711*** **(CDBI0227127)**
Pourthiaea amphidoxa **4**	**MT249053**	**Guangxi, China**	***S.Q. Chen 16816*** **(PE00738651)**
Pourthiaea amphidoxa **5**	**MT249052**	**Hunan, China**	***Y.F. Deng et al. 11700*** **(PE01598124)**
Pourthiaea amphidoxa **6**	**MT249059**	**Guizhou, China**	***B.B. Liu 2530*** **(PE)**
Pourthiaea amphidoxa **7**	**MT249061**	**Guizhou, China**	***M.T. An 0086*** **(PE00738553)**
Pourthiaea amphidoxa **8**	**MT249055**	**Chongqing, China**	***B.B. Liu P1918-4*** **(PE02090670)**
Pourthiaea amphidoxa **9**	**MT249062**	**Guangxi, China**	***Flora Survey Team of Hua Ping Nature Reserve H0528*** **(PE02108460)**

Species name	Accession number	Locality	Voucher
Pourthiaea arguta Decne. 1	MT249051	-	-
Pourthiaea arguta 2	MT249027	-	-
Pourthiaea arguta 3	MT249038	-	-
Pourthiaea arguta 4	MT249039	-	-
Pourthiaea arguta 5	MT249067	-	-
***Pourthiaea arguta* 6**	**MT249028**	**Guangdong, China**	***B.B. Liu 2124* (PE02080624)**
Pourthiaea arguta 7	MT249044	-	-
Pourthiaea arguta 8	MT249046	-	-
Pourthiaea arguta 9	MT249037	-	-
Pourthiaea arguta 10	MT249048	-	-
***Pourthiaea arguta* 11**	**MN061991**	**Sichuan, China**	***B.B. Liu 2208* (PE02080332)**
Pourthiaea arguta 12	MT249035	-	-
Pourthiaea blinii subsp. *blinii* (Lévl.) Iketani & H.Ohashi 1	MN061990	-	-
***Pourthiaea blinii* subsp. *blinii* 2**	**MT249060**	**Yunnan, China**	***S.S. Zhou 1907* (PE01498581)**
***Pourthiaea blinii* subsp. *blinii* 3**	**MT249034**	**Guizhou, China**	***B.B. Liu 2171* (PE02070183)**
***Pourthiaea hirsuta* (Hand.-Mazz.) Iketani & H.Ohashi 1**	**MT249031**	**Zhejiang, China**	***B.B. Liu 2385* (PE)**
Pourthiaea hirsuta 2	MT249032	-	-
***Pourthiaea hirsuta* 3**	**MN061986**	**Fujian, China**	***B.B. Liu 2595* (PE)**
Pourthiaea impressivena (Hayata) Iketani & H.Ohashi	MT249047	-	-
Pourthiaea parvifolia E.Pritz. ex Diels	OR149023	-	-
***Pourthiaea pilosicalyx* (T.T.Yu) Iketani & H.Ohashi 1**	**MN216024**	**Guizhou, China**	***G.F. Wang 29437* (PE01498390)**
Pourthiaea pilosicalyx 2	MT249045	-	-
Pourthiaea pustulata (Lindl.) B.B.Liu & D.Y.Hong 1	MT249033	-	-
Pourthiaea pustulata 2	MT249054	-	-
Pourthiaea salicifolia Decne.	KY419919	-	-
Pourthiaea sorbifolia (W.B.Liao & W.Guo) B.B.Liu & D.Y.Hong 1	MN061994	-	-
Pourthiaea sorbifolia 2	MT249065	-	-
***Pourthiaea tomentosa* (T.T.Yu & T.C.Ku) B.B.Liu & J.Wen 1**	**MT249066**	**Chongqing, China**	***G.F. Li 60885* (PE00739363)**
Pourthiaea tomentosa 2	MN061995	-	-
***Pourthiaea tsaii* (Rehder) Iketani & H.Ohashi**	**MN061987**	**Yunnan, China**	***B.B. Liu 2186* (PE02080401)**
***Pourthiaea villosa* Decne. 1**	**MT249063**	**Hondo, Japan**	***M. Furuse 50324* (PE01656471)**
Pourthiaea villosa 2	MT249058	-	-
Pourthiaea villosa 3	MN061989	-	-
Pourthiaea villosa 4	MT249029	-	-
***Pourthiaea villosa* 5**	**MT249041**	**Guangxi, China**	***B.B. Liu P1906-1* (PE02070280)**
***Pourthiaea villosa* 6**	**MT249050**	**Honshu, Japan**	***K. Yonekura 1907* (PE01523677)**
***Pourthiaea villosa* 7**	**MT249064**	**Japan**	***M. Furuse 29437* (PE01156868)**
***Pourthiaea villosa* 8**	**MT249057**	**Shandong, China**	***B.B. Liu P1993-1* (PE02070879)**
***Pourthiaea villosa* 9**	**MT249040**	**Jiangxi, China**	***B.B. Liu P1978-1* (PE02070057)**
***Pourthiaea villosa* 10**	**MT249056**	**Hubei, China**	***B.B. Liu P2085-2* (PE02071412)**

Species name	Accession number	Locality	Voucher
Pourthiaea villosa 11	MT249030	-	-
Pourthiaea villosa 12	MT249043	-	-
Pourthiaea villosa 13	MT249036	-	-
***Pourthiaea zhejiangensis* (P.L.Chiu) Iketani & H.Ohashi**	**MN061988**	**Zhejiang, China**	***L.Y. Wang 29509* (SYS)**
Pseudocydonia sinensis (Thouin) C.K.Schneid. 1	MN577871	-	-
Pseudocydonia sinensis 2	KT932967	-	-
Pseudocydonia sinensis 3	KX499860	-	-
***Pyracantha angustifolia* C.K.Schneid. 1**	**OR915905***	**Sichuan, China**	***FLPH Sichuan Expedition 151081* (PE)**
Pyracantha angustifolia 2	KY419957	-	-
Pyracantha coccinea M.Roem.	OM232776	-	-
***Pyracantha fortuneana* (Maxim.) H.L.Li 1**	**MK920290**	**Shaanxi, China**	***D.Y. Hong et al. 3443* (PE)**
Pyracantha fortuneana 2	KY419954	-	-
***Pyrus bretschneideri* Rehder 1**	**OR897831***	**Beijing, China**	***B.B. Liu 3977* (PE02234013)**
Pyrus bretschneideri 2	KX450881	-	-
Pyrus calleryana Decne. 1	OK545538	-	-
***Pyrus calleryana* 2**	**OR897832***	**Guangdong, China**	***B.B. Liu P1896-2* (PE02071584)**
***Pyrus communis* L. 1**	**MN577870**	**Beijing, China**	***B.B. Liu 3978* (PE)**
Pyrus communis 2	KX450879	-	-
Pyrus demetrii Kuth.	MT028510	-	-
Pyrus elata (G.Klotz) M.F.Fay & Christenh.	MN594522	-	-
Pyrus fauriei C.K.Schneid.	OK545529	-	-
Pyrus georgica Kuthath.	MN594523	-	-
Pyrus hopeiensis T.T.Yu	MF521826	-	-
Pyrus pashia Buch.-Ham. ex D.Don 1	KY626169	-	-
Pyrus pashia 2	KY419974	-	-
***Pyrus pashia* 3**	**OR897833***	**Sichuan, China**	***FLPH Sichuan Expedition 151625* (PE)**
***Pyrus phaeocarpa* Rehder 1**	**OR897834***	**Beijing, China**	***B.B. Liu et al. 3881* (PE)**
Pyrus phaeocarpa 2	MK488091	-	-
Pyrus pyraster (L.) Burgsd.	MT028511	-	-
Pyrus pyrifolia (Burm.f.) Nakai	KX450877	-	-
Pyrus salicifolia Pall.	MT028513	-	-
Pyrus spinosa Forssk.	HG737342	-	-
Pyrus trilocularis D.K.Zang & P.C.Huang	ON660523	-	-
Pyrus turcomanica Maleev	MN594524	-	-
Pyrus ussuriensis Maxim. 1	KX450883	-	-
***Pyrus ussuriensis* 2**	**OR897835***	**Liaoning, China**	***Y.N. Xiong & B.B. Liu 201812* (PE02234050)**
Pyrus ussuriensis 3	MK507863	-	-
Pyrus ussuriensis 4	MK172841	-	-
Rhaphiolepis angustissima (Hook.f.) B.B.Liu & J.Wen	MT890259	-	-
Rhaphiolepis bengalensis (Roxb.) B.B.Liu & J.Wen	MT876406	-	-
Rhaphiolepis bengalensis f. *angustifolia* (Cardot) B.B.Liu & J.Wen	KY419922	-	-

Species name	Accession number	Locality	Voucher
Rhaphiolepis bibas (Lour.) Galasso & Banfi 1	KT633951	-	-
Rhaphiolepis bibas 2	MK787302	-	-
Rhaphiolepis bibas 3	MN577877	-	-
Rhaphiolepis brevipetiolata J.E.Vidal	OK638182	-	-
***Rhaphiolepis cavaleriei* (H.Lév.) B.B.Liu & J.Wen 1**	**MK920283**	**Hunan, China**	***B.B. Liu 2585* (PE02070509)**
Rhaphiolepis cavaleriei 2	MT473722	-	-
Rhaphiolepis deflexa (Hemsl.) B.B.Liu & J.Wen 1	MT473724	-	-
***Rhaphiolepis deflexa* 2**	**MK920282**	**Guangdong, China**	***H.M. Li & B.B. Liu 201818* (PE)**
Rhaphiolepis dubia (Lindl.) B.B.Liu & J.Wen	MT890261	-	-
Rhaphiolepis elliptica (Lindl.) B.B.Liu & J.Wen	MT890256	-	-
Rhaphiolepis ferruginea F.P.Metcalf	MN577866	-	-
Rhaphiolepis fulvicoma (Chun ex W.B.Liao, F.F.Li & D.F.Cui) B.B.Liu & J.Wen	MT890255	-	-
Rhaphiolepis glabrescens (J.E.Vidal) B.B.Liu & J.Wen	MT890258	-	-
***Rhaphiolepis henryi* (Nakai) B.B.Liu & J.Wen**	**MN577880**	**Yunnan, China**	***J.S. Yang 91-002* (PE00799430)**
***Rhaphiolepis impressivena* Masam.**	**MN577886**	**Taiwan, China**	***T.C. Chen 11873* (PE01438973)**
Rhaphiolepis indica (L.) Lindl. 1	KY419927	-	-
Rhaphiolepis indica 2	MN577864	-	-
***Rhaphiolepis lanceolata* Hu**	**MN577867**	**Guangxi, China**	***B.B. Liu 2153* (PE)**
Rhaphiolepis laoshanica (W.B.Liao, Q.Fan & S.F.Chen) B.B.Liu & J.Wen 1	MT130714	-	-
Rhaphiolepis laoshanica 2	MT130715	-	-
Rhaphiolepis major Cardot	MN577887	-	-
Rhaphiolepis malipoensis (K.C.Kuan) B.B.Liu & J.Wen 1	MN577881	-	-
Rhaphiolepis malipoensis 2	LAU10002	-	-
***Rhaphiolepis obovata* (W.W.Sm.) B.B.Liu & J.Wen**	**MN577882**	**Yunnan, China**	***W.Q. Yin 580* (PE00799660)**
Rhaphiolepis philippinensis (S.Vidal) Kalkman	MT890262	-	-
Rhaphiolepis prinoides (Rehder & E.H.Wilson) B.B.Liu & J.Wen	MT876398	-	-
***Rhaphiolepis salicifolia* Lindl.**	**MN577876**	**Guangdong, China**	***H.M. Li et al. 201815* (PE)**
***Rhaphiolepis salwinensis* (Hand.-Mazz.) B.B.Liu & J.Wen**	**MN577883**	**Guizhou, China**	***Qingzang Team 7390* (PE01147725)**
Rhaphiolepis seguinii (H.Lév.) B.B.Liu & J.Wen 1	MN577885	-	-
Rhaphiolepis seguinii 2	MN577884	-	-
Rhaphiolepis serrata (J.E.Vidal) B.B.Liu & J.Wen	MT876401	-	-
Rhaphiolepis stipularis (Craib) B.B.Liu & J.Wen	MT890260	-	-
Rhaphiolepis tengyuehensis (W.W.Sm.) B.B.Liu & J.Wen	MT876397	-	-
Rhaphiolepis umbellata Makino 1	MN577868	-	-
Rhaphiolepis umbellata 2	KY419931	-	-
Rhaphiolepis williamtelliana (Champ. ex Benth.) B.B.Liu & J.Wen 1	MT473725	-	-
Rhaphiolepis williamtelliana 2	LAU10001	-	-

Species name	Accession number	Locality	Voucher
Sorbus aestivalis Koehne	ON049656	-	-
***Sorbus albopilosa* T.T.Yu & L.T.Lu 1**	**OR915913***	**Tibet, China**	***PE Xizang Expedition PE6822* (PE02330063)**
Sorbus albopilosa 2	ON049662	-	-
Sorbus alnifolia (Siebold & Zucc.) K.Koch 1	KY420010	-	-
Sorbus alnifolia2	MZ145061	-	-
***Sorbus alnifolia* 3**	**OR885566***	**Shandong, China**	***B.B. Liu 1998* (PE02071140)**
Sorbus amabilis Cheng ex T.T.Yu	MT357029	-	-
***Sorbus americana* Marshall 1**	**MZ984219**	**USA**	***L.R. Philippe et al. 42803* (PE02002820)**
***Sorbus americana* 2**	**OR915946***	**Gander, Canada**	***E. Rouleau 5564* (US03697424)**
***Sorbus aria* Wimm. ex Nyman**	**OR897837***	**Russian**	***s.coll. (4)82* (US03698455)**
***Sorbus aronioides* Rehder**	**OR915950***	**Shanxi, China**	***W.S. Gong et al. 3287* (PE01863128)**
***Sorbus arranensis* Hedl.**	**OR915935***	**Norway**	***s.coll. s.n.* (US03697966)**
***Sorbus astateria* (Cardot) Hand.-Mazz.**	**OR915952***	**Tibet, China**	***Eco Shi Plateau Formation 14121* (PE02093614)**
Sorbus aucuparia L. 1	MT610101	-	-
***Sorbus aucuparia* 2**	**OR915953***	**Poland**	***J. Zelazny s.n.* (PE01863032)**
***Sorbus bakonyensis* (Jáv.) Kárpáti**	**OR897827***	**Hungary**	***D. Zsolt et al. 64808* (PE01498819)**
***Sorbus borbasii* Jáv.**	**OR897859***	**Hungary**	***D. Zsolt et al. 64814* (PE01498820)**
***Sorbus buschiana* Zinserl.**	**OR915954***	**Russian**	***T. Zaikonnikova 5921a* (PE01683210)**
***Sorbus californica* Greene**	**OR915947***	**California, USA**	***A.A. Heller 14706* (US03697546)**
***Sorbus caloneura* Rehder 1**	**OR897830***	**Hunan, China**	***B.B. Liu 2583* (PE02071916)**
***Sorbus caloneura* 2**	**OR915955***	**Guangxi, China**	***B.B. Liu P1910-1* (PE02071948)**
***Sorbus cashmiriana* Hedl.**	**OR915991***	**India**	***W. Koelz 5195* (US03698176)**
Sorbus chamaemespilus Crantz	MN061999	-	-
Sorbus cibagouensis H.Peng & Z.J.Yin	ON049660	-	-
Sorbus commixta Hedl.	MK920288	-	-
Sorbus coronaria MacMill.	MN068247	-	-
***Sorbus coronata* (Cardot) T.T.Yu & Tsai 1**	**OR915907***	**Sichuan, China**	***FLPH Sichuan Expedition 151726* (PE)**
***Sorbus coronata* 2**	**OR915957***	**Sichuan, China**	***FLPH Sichuan Expedition 151374* (PE)**
***Sorbus corymbifera* (Miq.) T.H.Nguyên & Yakovlev**	**OR915958***	**Hainan, China**	***X.X. Zhou s.n.* (PE)**
***Sorbus cretica* (Lindl.) Fritsch & Rech.**	**OR897852***	**Bohemia, Czech Republic**	***M. Deyl s.n.* (US03697898)**
***Sorbus cuspidata* Hedl.**	**OR915922***	**Tibet, China**	***PE Xizang Expedition 7936* (PE)**
***Sorbus decora* (Sarg.) C.K.Schneid.**	**OR915948***	**Quebec, Canada**	***J.A. Calder 2680* (US03697599)**
***Sorbus discolor* (Maxim.) Maxim. 1**	**OR915986***	**Beijing, China**	***B. Liu 6746***
Sorbus discolor 2	OP613260	-	-
Sorbus domestica L. 1	MZ984208	-	-
Sorbus domestica 2	KY419956	-	-
***Sorbus domestica* 3**	**OR915994***	**Griechenland, Greece**	***J. Mattfeld 2839* (US03698004)**
***Sorbus dumosa* Greene**	**OR915949***	**New York, USA**	***E.D. Mcdonald s.n.* (US03697559)**
Sorbus dunnii Rehder	OK054488	-	-
Sorbus edulis K.Koch ex G.Kirchn.	MN061998	-	-
***Sorbus epidendron* Hand.-Mazz.**	**OR915990***	**Yunnan, China**	***B. Bartholomew et al. 237* (US03698096)**

Species name	Accession number	Locality	Voucher
Sorbus ferruginea Rehder	MZ984220	-	-
Sorbus filipes Hand.-Mazz. 1	ON049661	-	-
***Sorbus filipes* 2**	**OR915908***	**Sichuan, China**	***FLPH Sichuan Expedition 152814* (PE)**
***Sorbus folgneri* Rehder 1**	**OR915901***	**Chongqing, China**	***B.B. Liu P1921-7* (PE02070692)**
Sorbus folgneri 2	MK161058	-	-
Sorbus foliolosa Spach 1	ON049652	-	-
***Sorbus foliolosa* 2**	**OR915909***	**Tibet, China**	***Y.S. Chen et al. 13-1493* (PE01992580)**
***Sorbus globosa* T.T.Yu & H.T.Tsai**	**OR915985***	**Yunnan, China**	***B. Liu 2470***
***Sorbus graeca* (Spach) Lodd. ex S.Schauer**	**OR915960***	**Croatia**	***V. Mikolas et al. s.n.* (PE02022194)**
Sorbus helenae Koehne 1	KY419924	-	-
Sorbus helenae 2	ON049667	-	-
Sorbus hemsleyi Rehder 1	ON262427	-	-
***Sorbus hemsleyi* 2**	**MZ984221**	**Sichuan, China**	***J.I. Jeon et al. SI1557* (PE01993957)**
***Sorbus himalaica* Gabrieljan**	**OR897829***	**Nepal**	***C.S. Chang et al. NE020422* (PE01597503)**
***Sorbus hupehensis* C.K.Schneid.**	**OR915961***	**Sichuan, China**	***C.S. Chang et al. SI0955* (PE02007902)**
Sorbus hupehensis var. *paucijuga* (D.K.Zang & P.C.Huang) L.T.Lu	MT916771	-	-
***Sorbus hybrida* L.**	**OR915937***	**Helsinki, Finland**	***A. Haakana s.n.* (US03697979)**
Sorbus hypoglauca (Cardot) Hand.-Mazz.	ON049664	-	-
Sorbus insignis Hedl. 1	MT677871	-	-
***Sorbus insignis* 2**	**OR915962***	**Yunnan, China**	***Qingzang Team 6939* (PE01596471)**
***Sorbus intermedia* (Ehrh.) Pers.**	**OR915938***	**Uppland, Sweden**	***C.G. Alm & H. Smith 435* (US03697970)**
***Sorbus istriaca* Kárpáti**	**OR915939***	**Slovenia**	***V. Mikolas et al. s.n.* (US03697968)**
***Sorbus keissleri* Rehder**	**OR915963***	**Chongqing, China**	***PE Sanxia Expedition 0463* (PE01710431)**
***Sorbus kiukiangensis* T.T.Yu**	**OR915919***	**Yunnan, China**	***X.H. Jin et al. ST1263* (PE01969766)**
***Sorbus koehneana* C.K.Schneid. 1**	**OR915899***	**Hubei, China**	***B.B. Liu 2279* (PE02069831)**
Sorbus koehneana 2	OQ992656	-	-
***Sorbus macrantha* Merr.**	**OR915904***	**Sichuan, China**	***FLPH Sichuan Expedition 150829* (PE)**
***Sorbus matsumurana* Koehne 1**	**OR915980***	**Kokkaido, Japan**	***E.H. Wilson 7281* (US03698324)**
Sorbus matsumurana 2	MZ984222	-	-
***Sorbus mayeri* (Kárpáti) Mikoláš**	**OR897853***	**Croatia**	***V. Mikolas et al. s.n.* (PE02012130)**
***Sorbus megalocarpa* Rehder 1**	**OR915911***	**Tibet, China**	***FLPH Tibet Expedition 12-1867* (PE01960095)**
Sorbus megalocarpa 2	ON259046	-	-
***Sorbus meliosmifolia* Rehder**	**OR915964***	**Gansu, China**	***Baishuijiang Expedition 0409* (PE01857052)**
***Sorbus microphylla* Wenz.**	**OR915906***	**Sichuan, China**	***FLPH Sichuan Expedition 151286* (PE)**
***Sorbus mougeotii* Soy.-Will. & Godr. 1**	**OR915940***	**Gallia, France**	***H. Burdet et al. 134* (US03697969)**
***Sorbus mougeotii* 2**	**OR915965***	**USA**	***Kim & Altvatter 7023V95* (PE01598121)**
Sorbus multijuga Koehne 1	OP613261	-	-
***Sorbus multijuga* 2**	**OR915966***	**Sichuan, China**	***D.E. Boufford et al. 27546* (PE01640135)**
Sorbus munda Koehne	MT683851	-	-
***Sorbus ochracea* (Hand.-Mazz.) J.E.Vidal**	**OR915967***	**Yunnan, China**	***E.D. Liu et al. 3639* (PE01921218)**

Species name	Accession number	Locality	Voucher
Sorbus oligodonta **(Cardot) Hand.-Mazz.**	**OR915912***	**Tibet, China**	***PE Xizang Expedition PE5687*** **(PE02330070)**
Sorbus pallescens **Rehder**	**OR915968***	**Sichuan, China**	***D.E. Boufford et al. 33170*** **(PE01579585)**
Sorbus pannonica **Kárpáti**	**OR915969***	**Croatia**	***V. Mikolas et al. s.n.*** **(PE02022195)**
Sorbus persica **Hedl. 1**	**OR915987***	**Uzbekistan**	***F.R. Fosberg & S.S. Ikonnikow 55873*** **(US03698332)**
Sorbus persica **2**	**OR915970***	**Russian**	***V. Goloskokov 4461*** **(PE01683284)**
Sorbus pohuashanensis Hedl. 1	OP613257	-	-
Sorbus pohuashanensis **2**	**OR915971***	**China**	***S.M. Zhang s.n.*** **(PE)**
Sorbus pohuashanensis **3**	**OR915917***	**Jilin, China**	***Y.N. Xiong & B.B. Liu 201803*** **(PE)**
Sorbus poteriifolia **Hand.-Mazz.**	**OR915972***	**Yunnan, China**	***Qingzang Team 8804*** **(PE01159949)**
Sorbus prattii Koehne 1	MK814479	-	-
Sorbus prattii **2**	**OR915915***	**Tibet, China**	***PE Xizang Expedition PE6854*** **(PE02330094)**
Sorbus pseudovilmorinii **McAll.**	**OR915973***	**Sichuan, China**	***D.E. Boufford et al. 37204*** **(PE01902219)**
Sorbus pteridophylla Hand.-Mazz. 1	ON049651	-	-
Sorbus pteridophylla 2	MZ984223	-	-
Sorbus pteridophylla **3**	**OR915916***	**Tibet, China**	***PE Xizang Expedition 3354*** **(PE)**
Sorbus randaiensis **Koidz.**	**OR915974***	**Taiwan, China**	***W.H. Hu et al. 2814*** **(PE01821897)**
Sorbus reducta Diels	OP613259	-	-
Sorbus rehderiana **Koehne 1**	**OR915914***	**Tibet, China**	***PE Xizang Expedition PE6297*** **(PE)**
Sorbus rehderiana 2	OK012001	-	-
Sorbus rehderiana var. *cupreonitens* Hand.-Mazz.	ON049663	-	-
Sorbus rehderiana **var.** ***grosseserrata*** **Koehne**	**OR897860***	**Tibet, China**	***Y.S. Chen 13-1489*** **(PE01992578)**
Sorbus rhamnoides Rehder	KY419962	-	-
Sorbus rufopilosa C.K.Schneid. 1	KY419990	-	-
Sorbus rufopilosa **2**	**OR915921***	**Tibet, China**	***PE Xizang Expedition 7895*** **(PE02333234)**
Sorbus rutilans McAll.	ON049654	-	-
Sorbus salwinensis **T.T.Yu & L.T.Lu**	**OR915975***	**Yunnan, China**	***Qingzang Team 9784*** **(PE01172077)**
Sorbus sambucifolia **(Cham. & Schltdl.) M.Roem. 1**	**OR915976***	**Japan**	***Fusako & Yamazaki 6628*** **(PE01638241)**
Sorbus sambucifolia **2**	**OR915956***	**Montana, USA**	***J.L. McMullen 2984*** **(US03697621)**
Sorbus sambucifolia **3**	**OR915951***	**Alaska, USA**	***A. Nelson & R.A .Nelson 4149*** **(US03697557)**
Sorbus sargentiana **Koehne 1**	**OR915977***	**Sichuan, China**	***H.G. Xu 1532*** **(PE01640045)**
Sorbus sargentiana 2	ON049655	-	-
Sorbus scalaris **Koehne**	**OR915920***	**Yunnan, China**	***X.H. Jin et al. ST2145*** **(PE01978718)**
Sorbus scopulina **Greene 1**	**OR915959***	**Colorado, USA**	***J. Barrell & S. Spongberg 66-73*** **(US03697703)**
Sorbus scopulina **2**	**OR915978***	**USA**	***B. Barhtolomew 6000*** **(PE01638246)**
Sorbus semi-incisa **Borbás**	**OR915941***	**Budapest, Hongary**	***J.B .Kümmerle s.n.*** **(US03698033)**
Sorbus setschwanensis Koehne	MK914535	-	-
Sorbus sibirica **Hedl.**	**OR897838***	**Russia**	***S. Kharkevich & T. Buch 526*** **(PE01638237)**
Sorbus sitchensis **var.** ***grayi*** **(Wenz.) C.L.Hitchc. 1**	**OR897862***	**USA**	***Richard & R. Halse 8075*** **(PE01921537)**

Species name	Accession number	Locality	Voucher
***Sorbus sitchensis* var. *grayi* 2**	**OR897861***	**Vancouver, Canada**	***J.A. Calder & K.T. Mackay 32269* (US03697841)**
***Sorbus slavnicensis* Kárpáti 1**	**MZ984224**	**Croatia**	***V. Mikolas et al. s.n.* (PE02012131)**
***Sorbus slavnicensis* 2**	**OR915942***	**Slovenia**	***V. Mikolas & W. Starmuhler s.n.* (US03698030)**
***Sorbus* sp. 1**	**OR897839***	**Tibet, China**	***W.B. Ju et al. YLZB0591***
***Sorbus* sp. 2**	**OR915936***	**Montsalvens, Switzerland**	***Jaquel 15* (US03697991)**
Sorbus sp. 3	KY419964	-	-
***Sorbus suecica* Briq**	**OR897854***	**Oland Island, Sweden**	***F.R. Fosberg 32735* (US03698026)**
***Sorbus tapashana* C.K.Schneid.**	**OR897863***	**Gansu, China**	***Y.M. Yuan 1104* (PE01596429)**
***Sorbus tauricola* Zaik. ex Sennikov**	**OR897836***	**Russia**	***T. Zaikonnikova 7011* (PE01499098)**
***Sorbus thibetica* (Cardot) Hand.-Mazz. 1**	**OR915981***	**Tibet, China**	***PE Xizang Expedition 3240* (PE)**
Sorbus thibetica 2	MK920287	-	-
***Sorbus thomsonii* (King ex Hook.f.) Rehder**	**OR915982***	**Sichuan, China**	***PE Gulin Expedition 0159* (PE01864938)**
Sorbus tianschanica Rupr.	MK920289	-	-
***Sorbus torminalis* (L.) Crantz 1**	**OR915945***	**Hongary**	***J.B. Kummerle 754* (US03698129)**
Sorbus torminalis 2	MN062005	-	-
Sorbus torminalis 3	KY457242	-	-
***Sorbus torminalis* 4**	**OR915944***	**Madrid, Spain**	***A. Rodriguez s.n.* (US03698124)**
Sorbus ulleungensis Chin S.Chang	MG011706	-	-
***Sorbus umbellata* (Desf.) Fritsch**	**OR915943***	**Bohemia, Czech**	***R. Missbach s.n.* (US03698121)**
***Sorbus wilsoniana* C.K.Schneid. 1**	**OR915983***	**Sichuan, China**	***PE Gulin Expedition 1059* (PE01864943)**
Sorbus wilsoniana 2	ON049657	-	-
***Sorbus xanthoneura* Rehder**	**OR897855***	**Hubei, China**	***B. Bartholomew et al. 1317* (PE00997146)**
***Sorbus zahlbruckneri* C.K.Schneid.**	**OR915984***	**Hunan, China**	***Y.B. Luo 3104* (PE01499118)**
***Stranvaesia lasiogyna* (Franch.) B.B.Liu 1**	**OP021694**	**Yunnan, China**	***H. Wang 3666* (PE01439780)**
***Stranvaesia lasiogyna* 2**	**OP021696**	**Sichuan, China**	***Qingzang Team 11412* (PE01158556)**
***Stranvaesia lasiogyna* 3**	**OP021697**	**Sichuan, China**	***Qingzang Team 13564* (PE00336586)**
Stranvaesia nussia Decne. 1	MK920285	-	-
Stranvaesia nussia 2	MK920284	-	-
Stranvaesia oblanceolata Stapf 1	MK920280	-	-
***Stranvaesia oblanceolata* 2**	**OP021701**	**Yunnan, China**	***P.Y. Mao 06729* (PE00739347)**
***Stranvaesia oblanceolata* 3**	**OP021700**	**Yunnan, China**	***G. Forrest 11855* (PE00739340)**
***Vauquelinia australis* Standl.**	**MN068250**	**Oaxaca, Mexico**	***W. Hess & G. Wilhelm 4382* (US00908940)**
Vauquelinia californica (Torr.) Sarg.	KY419925	-	
***Vauquelinia californica* subsp. *sonorensis* W.J.Hess & Henrickson**	**MN068269**	**Baja California, Mexico**	***J. Henrickson 20281* (US00903444)**
***Vauquelinia corymbosa* subsp. *heterodon* (I.M.Johnst.) W.J.Hess & Henrickson**	**MN068249**	**California, USA**	***J. Henrickson 189230* (US00903439)**
***Vauquelinia pauciflora* Standl.**	**MN068251**	**Arizona, USA**	***F. Reichenbacher 872* (US03694614)**
Weniomeles bodinieri (H.Lév.) B.B.Liu 1	MK920276	-	-
***Weniomeles bodinieri* 2**	**OP021698**	**Jiangxi, China**	***B.B. Liu P1941-3* (PE02070677)**
***Weniomeles bodinieri* 3**	**OP021695**	**Guangxi, China**	***Y.M. Wang 322* (PE01439811)**

Plastome assembly and annotation

In our study, we adopted the Successive Approach combining Reference-based and De novo assembly (SARD approach: Liu et al. 2021, 2023b; Jin et al. 2024), a method offering the possibility of obtaining nearly all plastome-related reads, thus facilitating the production of high-quality chloroplast genomes even from datasets with low coverage. For initial data preparation, we used Trimmomatic v. 0.33 (Bolger et al. 2014) for quality trimming and adapter removal, complemented by FastQC v. 0.11.8 (Andrews 2018) for quality assessment. We then employed NOVOPlasty v. 4.3.3 (Dierckxsens et al. 2016), a *de novo* assembly program known for its accuracy and efficiency. The seed sequence chosen was the ribulose-1,5-bisphosphate carboxylase/oxygenase large subunit (*rbc*L), a 600 bp plastome-specific sequence with absence in the mitochondrial genome, to initiate the assembly process. While NOVOPlasty performs well for the deeply sequenced data, the SARD approach is notably effective even with lower-quality raw data. For the assembly process with SARD approach, all plastome-related reads were aligned to a reference genome using Bowtie2 (Langmead and Salzberg 2012), followed by generating a consensus sequence through Geneious Prime (Kearse et al. 2012). Concurrently, a *de novo* assembly was conducted using SPAdes v. 3.13.1 (Bankevich et al. 2012), which included error correction and employed a range of K-mer lengths (21, 33, 55, 77). The final step involved aligning scaffolds from the de novo assembly and contigs from NOVOPlasty to the draft plastome, and this step will effectively correct errors and ambiguities introduced from the first step, yielding a high-quality complete plastome.

We annotated the assembled plastid genomes using the PGA tool (Qu et al. 2019) with a closely related plastome as a reference. This process was followed by a thorough manual review of the coding sequences. We then translated these sequences into proteins using Geneious Prime to confirm the accuracy of the start and stop codons. To precisely delineate the boundaries of the large-single copy (LSC), small-single copy (SSC), and inverted repeats (IRs) regions, we employed the Find Repeats function in Geneious Prime based on the characteristic presence of two reverse complementary repeats in the plastomes of Rosaceae species. After this detailed annotation process, we converted our custom annotations into the format required for NCBI submissions. This involved creating both FASTA files and five-column feature tables, a task we accomplished using the GB2sequin tool (Lehwark and Greiner 2019).

Data matrix generation and sequence cleaning

Our previous studies have consistently shown that phylogenetic trees derived from entire plastome datasets and the 79 concatenated plastid protein-coding sequences (plastid CDSs) yield almost identical topologies within the apple tribe framework (Liu et al. 2020a, 2020b, 2022). This similarity underscores the minimal influence of potential misalignments in the intron regions. Consequently, we opted to utilize the whole plastome for phylogenetic inference in this study. To mitigate systematic errors stemming from alignment inaccuracies, we applied trimAL v. 1.2 (Capella-Gutiérrez et al. 2009) to fine-tune the alignment of the plastome. Additionally, we incorporated Spruceup (Borowiec

2019) to identify, visualize, and eliminate outlier sequences. In this process, we set a window size of 50 and an overlap of 25, ensuring a rigorous and precise approach to enhance the quality and reliability of our phylogenetic analysis.

Phylogenomic analyses based on various inference methods

In our comprehensive study, we implemented a variety of robust inference methodologies to achieve precise and reliable phylogenetic results. Initially, we employed PartitionFinder2 (Stamatakis 2006; Lanfear et al. 2016) to identify the most appropriate partitioning schemes and molecular evolution models, utilizing its default settings. This critical step ensured that the chosen models and schemes were best suited for our dataset, enhancing the accuracy of our subsequent analyses.

For estimating Maximum Likelihood (ML) trees, we utilized the advanced capabilities of IQ-TREE2 v. 2.2.0.3 (Minh et al. 2020), conducting analyses with 1000 SH-aLRT and ultrafast bootstrap replicates. This method provided us with a robust statistical framework to evaluate the reliability of the phylogenetic tree branches. In parallel, we used RAxML v. 8.2.12 (Stamatakis 2014), adopting the GTRGAMMA model for each partition. This process included running 200 rapid bootstrap replicates to support the clade structures in our phylogenetic tree, thus ensuring a comprehensive and reliable assessment of clade support.

Nomenclatural synopsis and typification

Over 11 years, from 2013 to 2023, we conducted an in-depth taxonomic study to examine all names published under the genus *Photinia* and its related genera. This comprehensive review was not a trivial undertaking; it involved a thorough exploration of multiple renowned online botanical databases. These included Tropicos (accessible at https://www.tropicos.org), the International Plant Names Index (IPNI) at https://www.ipni.org/, and The Plant List, available at http://www.theplantlist.org/. Our investigation extended beyond these databases to encompass a wide range of literature pertinent to the genus *Photinia*, ensuring no relevant information was overlooked.

Results

A plastid phylogenetic backbone of *Photinia* and allies

We newly generated 147 complete plastomes for this study, and we collected 563 plastomes representing 370 species to create a detailed phylogenetic framework for the apple tribe. Our efforts resulted in a comprehensive aligned plastome matrix that was used for ML analyses. This matrix, spanning a significant length of 158,752 base pairs, was curated with poorly aligned regions being carefully trimmed to ensure the accuracy of our phylogenetic inferences.

We successfully generated two phylogenetic trees using the ML method, i.e., RAxML and IQ-TREE trees. All these phylogenetic trees consistently corroborated the monophyly of three major clades within the apple tribe (Fig. 3, Suppl. materials 1, 2). Clade I, identified as the most basal of the three, comprises two genera: *Lindleya* and *Kageneckia*. This clade lays the foundation of our phylo-

genetic understanding of the tribe. Clades II and III, on the other hand, demonstrate a sister relationship to each other and, collectively, they are sister to Clade I. Clade II is uniquely composed of a single genus, *Vauquelinia*, highlighting its distinct evolutionary path within the tribe. Clade III is particularly noteworthy as it corresponds to what was previously known as the subfamily Maloideae, encompassing approximately 24 genera. This finding solidifies the genetic distinctiveness of these genera within the apple tribe. However, there were notable exceptions, including *Amelanchier*, *Malus*, *Sorbus* s.l., and *Stranvaesia*.

Discussion

Refining the phylogenetic backbone with plastome data: towards an updated infra-tribal classification of Maleae

In our study, we integrated representative species from three dry-fruited genera—*Kageneckia*, *Lindleya*, and *Vauquelinia*—alongside a comprehensive sampling of pome-bearing genera to estimate their maternally phylogenetic relationships. The inferred plastid phylogeny (Fig. 3, Suppl. materials 1, 2) corroborated the monophyly of these groups, each representing distinct subtribes within Maleae. Furthermore, this topology indicates a clear successive sister relationship between a combined clade (*Kageneckia* + *Lindleya*) and *Vauquelinia*, relative to the pome-bearing genera. Morphologically, these three clades can be easily distinguished, a distinction further elaborated in the identification key provided later.

However, the phylogenetic relationships among these subtribes have been subject to variability across different studies leveraging diverse genomic datasets (Fig. 4). Phylogenies inferred from transcriptomic data (Xiang et al. 2017; Zhang et al. 2023) reveal a topology similar to the plastome-based topology analyses among these three subtribes, i.e., combined clades of Vauqueliniinae and Malinae together sister to Lindleyinae (Fig. 4A). Conversely, recent phylogenomic studies employing ML inference method with hundreds of single-copy nuclear genes (SCN genes) datasets–785 genes in Liu et al. (2022) and 426 genes in Jin et al. (2023)—have elucidated an alternative phylogenetic hypothesis, (Malinae, Lindleyinae) Vauqueliniinae (Fig. 4B). In contrast, a species tree inferred through a coalescent-based method (Jin et al. 2023) presents a unique topology, i.e., the sister relationship between Lindleyinae and Vauqueliniinae, and then together sister to Malinae (Fig. 4C). Despite the emergence of three divergent topologies, the monophyly of these three clades has been consistently supported across multiple previous studies. This convergence underscores the robustness of this newly proposed infra-tribal taxonomic classification within tribe Maleae, despite the methodological diversity and inherent complexities of phylogenomic analysis.

While the maternally inherited characteristics of plastomes in the Maleae tribe obviate the need for orthology inference, their utility is somewhat limited in identifying hybridization and polyploidization events (McKain et al. 2018; Guo et al. 2023). The complex evolutionary processes within Maleae, such as hybridization, polyploidization, and incomplete lineage sorting, have profoundly influenced its origin and diversification. This is evident from a series of phylogenomic studies that highlight cytonuclear discordance within the tribe (refer to Fig. 2A, B and studies by Liu et al. 2022; Hodel et al. 2023; Jin et al. 2023; Zhang et al. 2023).

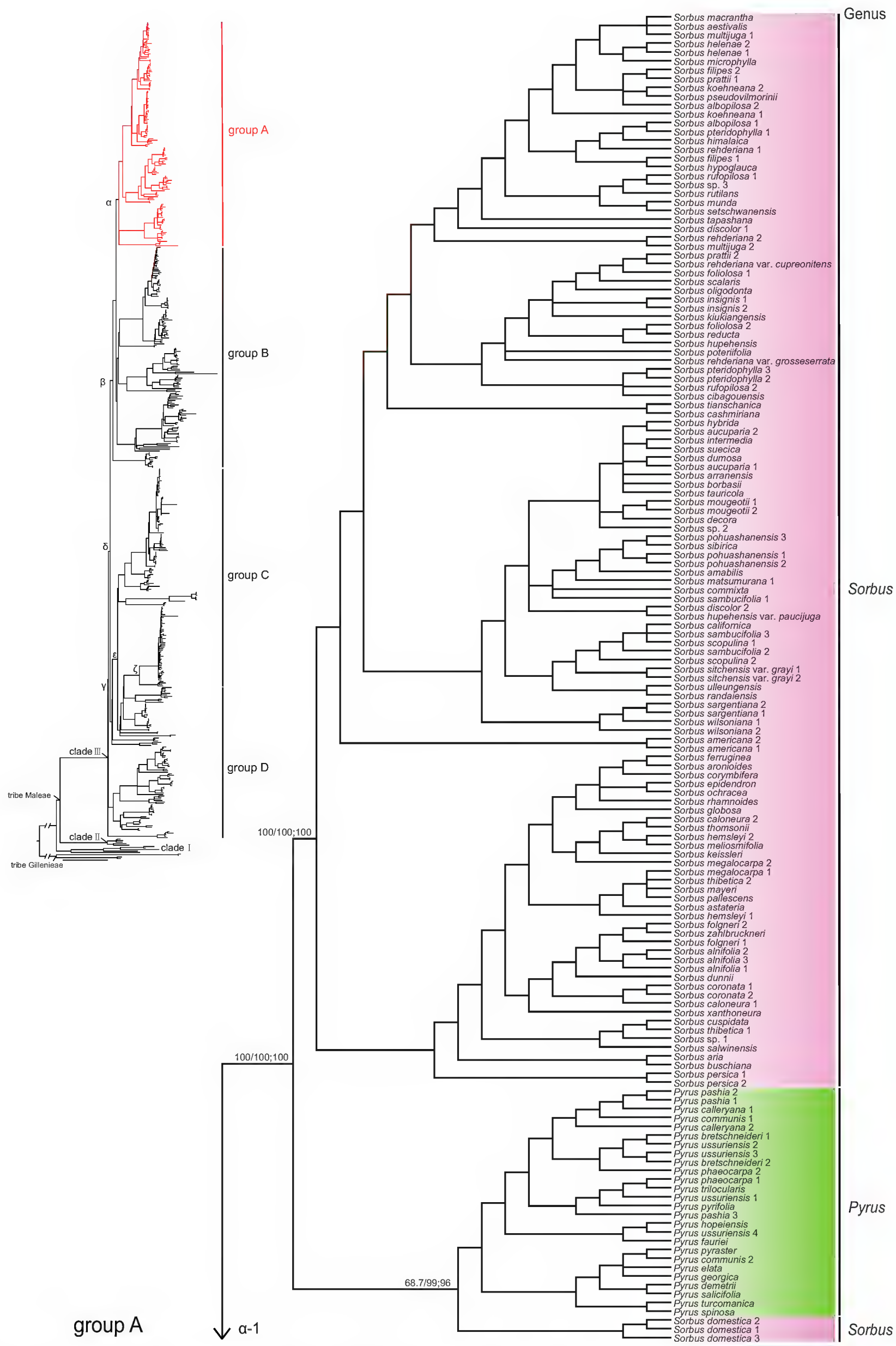


Figure 3. A comprehensive phylogenetic backbone of the apple tribe Maleae, including 563 plastomes across 370 species and 26 genera, estimated by IQ-TREE2 based on the whole plastome dataset. Each of the 26 genera is represented by a unique color for clear distinction. Owing to the extensive scope of the tree, it is segmented into four distinct groups (labeled Group A, B, C, and D), each depicted in separate images. The interconnections among these subgroups are denoted by branch connectors labeled α, β, γ, δ, ε, and ζ.

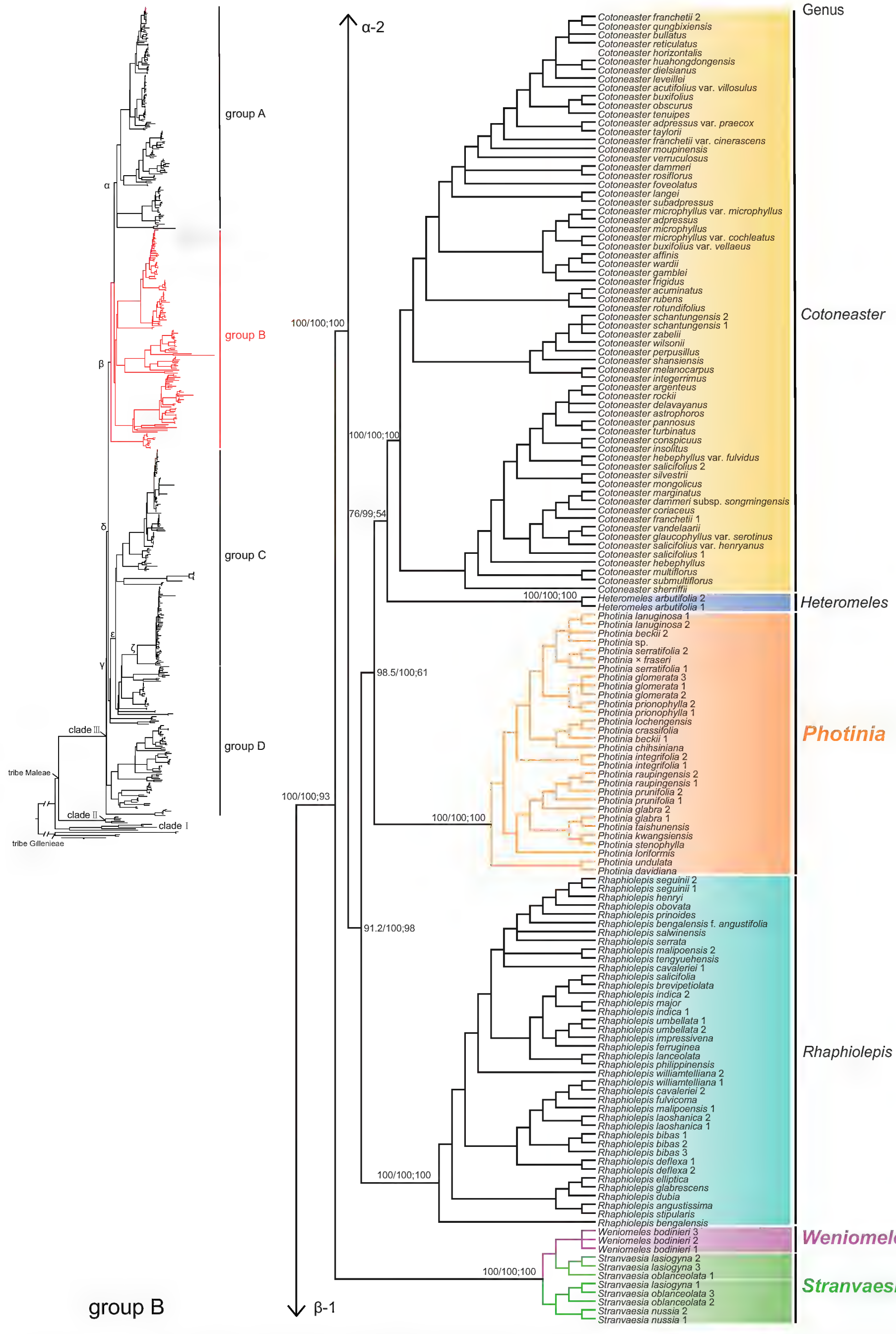


Figure 3. Continued.

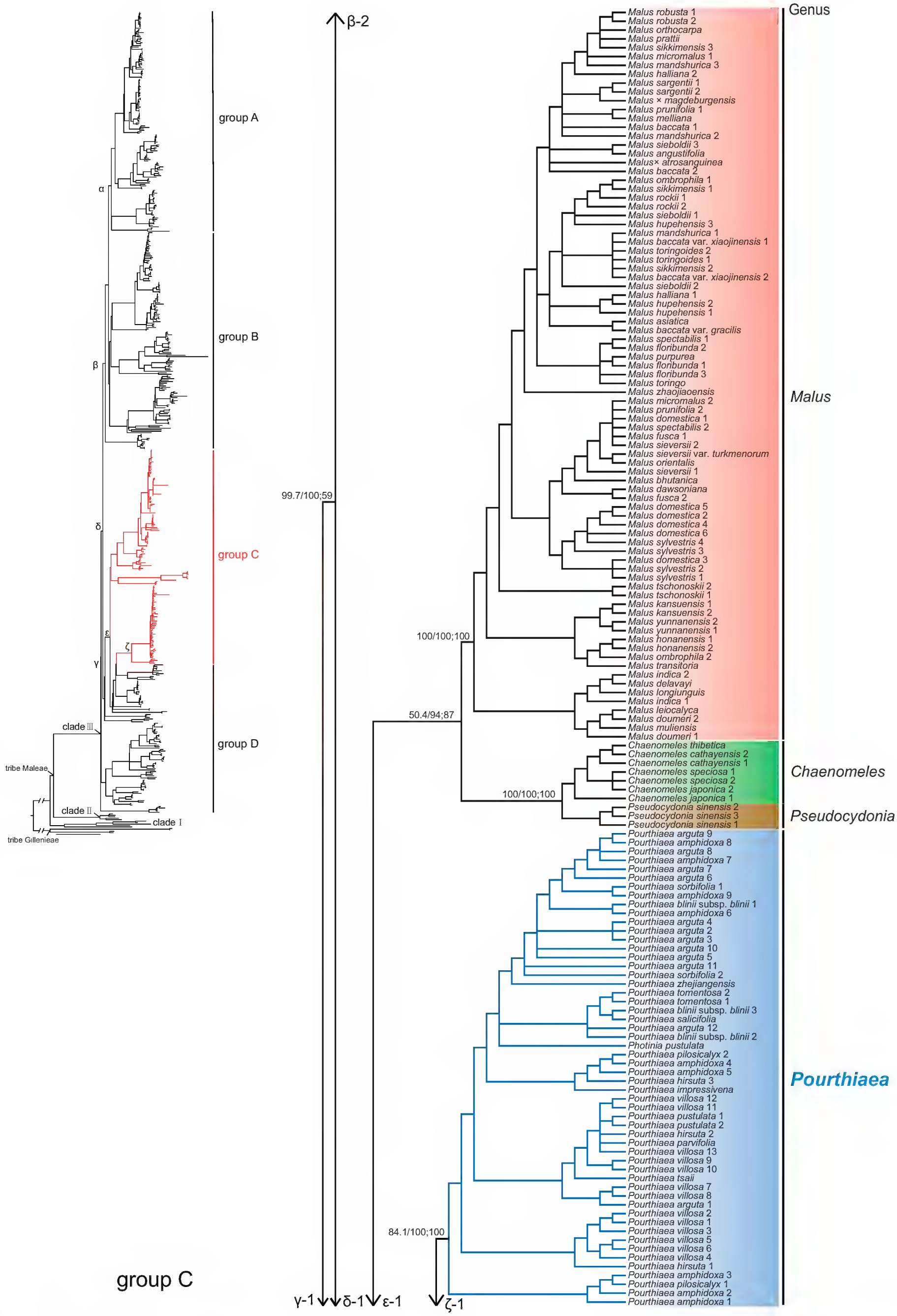


Figure 3. Continued.

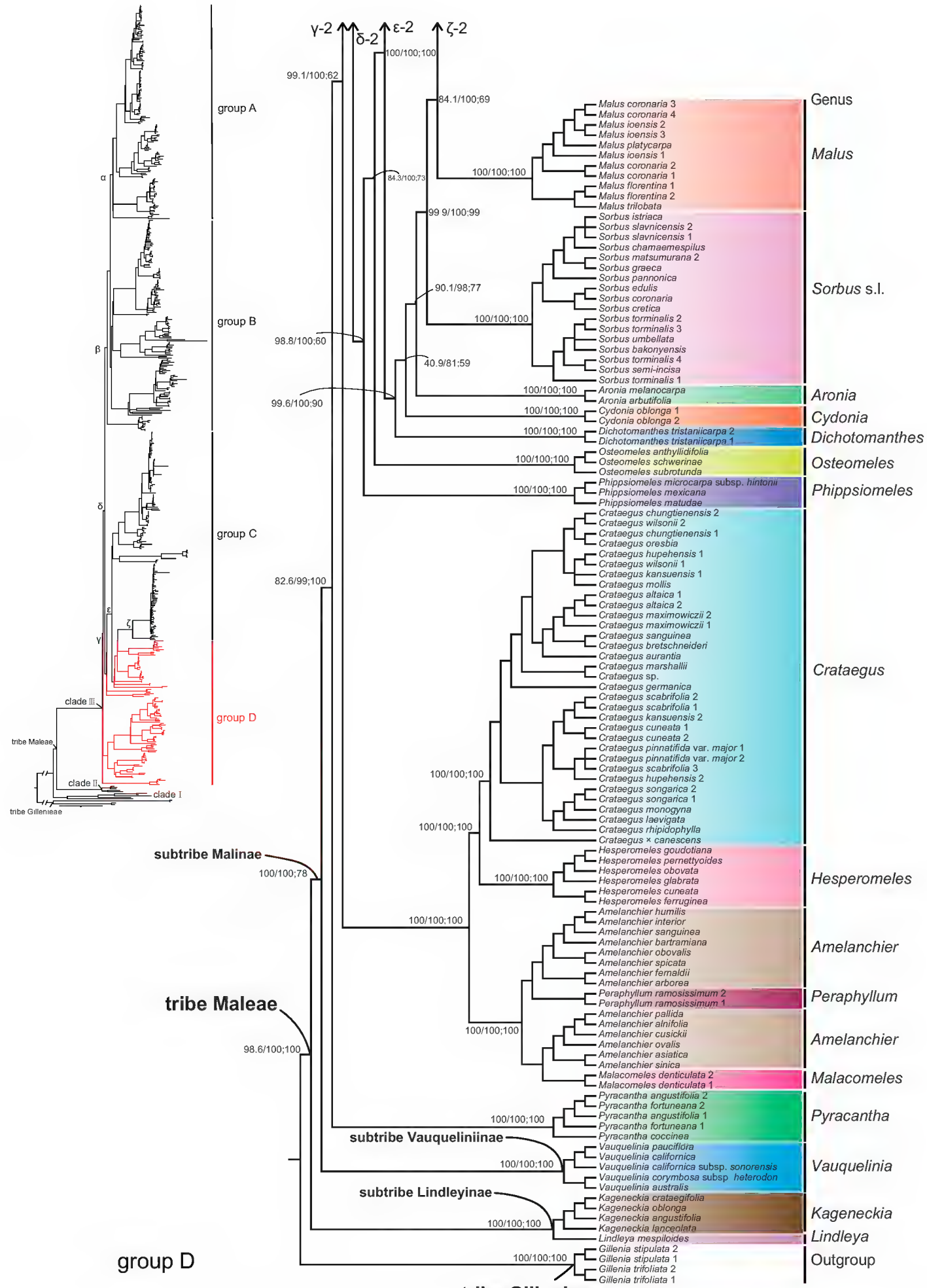


Figure 3. Continued.

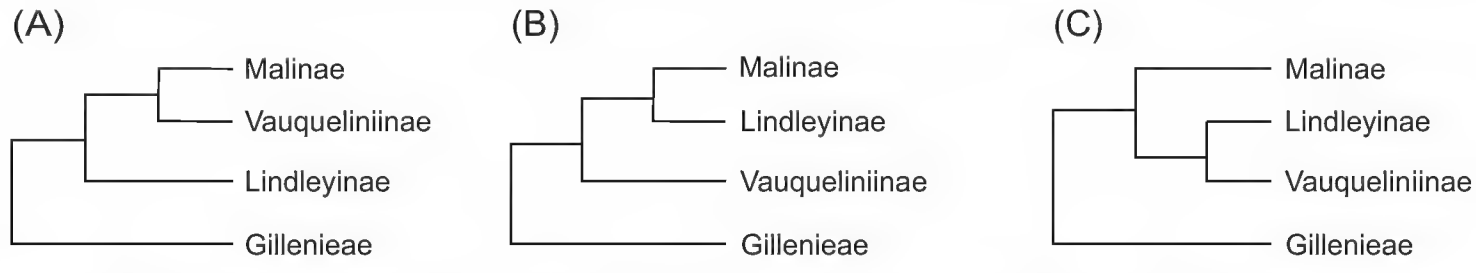


Figure 4. Phylogenetic hypotheses among subtribes within the apple tribe Maleae. **A** plastome-based topology (current study; Liu et al. 2020a); 11 plastid regions- and nuclear ribosomal internal transcribed spacer (nrITS)-based topology (*atp*B-*rbc*L, *psb*A-*trn*H, *rbc*L, *rpl*16 intron, *rpl*20-*rps*12, *rps*16 intron, *trn*C-*ycf*6, *trn*G-*trn*S, *trn*H-*rpl*2, *trn*L-*trn*F, and *trn*K + *mat*K; Lo and Donoghue 2012); transcriptome-based topology (Xiang et al. 2017; Zhang et al. 2023) **B** single-copy nuclear genes (SCN genes)-based topology (inferred from Maximum Likelihood (ML) methods: Liu et al. 2022; Jin et al. 2023) **C** SCN genes-based topology (ASTRAL-III species tree: Liu et al. 2022; Jin et al. 2023).

However, the phylogenetic topologies inferred from hundreds of SCN genes, as illustrated in our previous studies (Liu et al. 2022; Jin et al. 2023), lend strong support to the three major clades identified in our plastid tree (Fig. 3, Suppl. materials 1, 2). These findings have led us to formally propose a taxonomic system for the tribe Maleae, delineating it into three subtribes, i.e., subtribe Lindleyinae, subtribe Malinae, and subtribe Vauqueliniinae. Consequently, this study not only elucidates the phylogenetic placement of these dry-fruited genera within the tribe but also significantly contributes to refining their taxonomy.

Tribe Maleae Small, Man. S.E. Fl. 632. 1933. Type: *Malus* Mill.

= Pyreae Baill., Hist. Pl. 1: 442, 475. 1869. Type: *Pyrus* L.

Key to subtribes of Maleae

1a Leaf margins not horny; carpels ± adnate to hypanthium; flowers: perianth and androecium epigynous; fruit pome; seed not winged or pyrenes; Northern Hemisphere, rarely extending to Central America; 2n = 34 ... **subtribe Malinae**

1b Leaf margins usually horny; carpels free; flowers: perianth and androecium perigynous; Fruit woody capsule or follicle; seed winged; Central & South America; 2n = 30 or 34 ..... **2**

2a Fruit capsule or follicle; seed 2 or many; 2n = 34 ..... **subtribe Lindleyinae**

2b Fruit capsule; seed 2; 2n = 30 ..... **subtribe Vauqueliniinae**

1. Subtribe Malinae Reveal, Phytoneuron 2012-33: 2. 2012.

≡ Malaceae Small, Fl. S.E. U.S. [Small]. 529. 1903, nom. cons. Type: *Malus* Mill.

Remark. This tribe contains ca. 24 genera (ca. 905 species), *Amelanchier* (24 species), *Aronia* (two species), *Chaenomeles* (four species), *Chamaemeles* (one species), *Cotoneaster* (261 species), *Crataegus* (222 species), *Cydonia* (one species), *Dichotomanthes* (one species), *Hesperomeles* (11 species), *Heteromeles* (one species), *Malacomeles* (five species), *Malus* (33 species), *Osteomeles* (two species), *Peraphyllum* (one species), *Phippsiomeles* (five species), *Photinia* (27 species), *Pourthiaea* (seven species), *Pseudocydonia* (one species), *Pyracantha* (six species), *Pyrus* (83 species), *Rhaphiolepis* (42 species), *Sorbus* s.l. (*Chamaemespilus*, *Aria*, *Torminalis*, *Cormus*, *Micromeles*, and *Sorbus* s.s.; ca. 160 species), *Stranvaesia* (three species), and *Weniomeles* (two species). 2n = 34.

2. Subtribe Lindleyinae Reveal, Phytoneuron 2012-37: 217. 2012.

≡ Lindleyaceae J.Agardh, Theoria Syst. Pl. 166. 1858. Type: *Lindleya* Kunth., nom. cons.

Remark. This subtribe contains two genera, *Lindleya* (one species) and *Kageneckia* (ca. three species), distributed in Central and South America. 2n = 34.

3. Subtribe Vauqueliniinae B.B.Liu, subtr. nov.
urn:lsid:ipni.org:names:77342732-1

Type. ***Vauquelinia*** Corrêa ex Bonpl.

Description. Large shrubs or small trees, evergreen. Leaves simple, coriaceous, with serrate margins. Inflorescences terminal, 15–25+-flowered, compound corymbs. Flowers bisexual, 5-merous. Hypanthium hemispherical. Sepals 5, erect, broadly ovate, valvate. Petals 5, white, oblong-ovate to oblong-obovate. Stamens 18-20. Carpels 5, free from hypanthium, ventrally connate; ovules 2 per cell, ascending, apotropous. Fruits capsules, broadly ovoid, sericeous, ventrally (fully) and dorsally (in distal 1/2) dehiscent, splitting into 5 follicles; hypanthium persistent; sepals persistent, erect; styles persistent. Seeds 2 per follicle. 2n = 30.

Remark. This subtribe comprises only one genus, *Vauquelinia*, with about three species distributed in Mexico and the Southwestern United States.

A taxonomic synopsis of *Photinia* and its morphological allies in the Old World

Within the Old World, the genus *Photinia* and its morphologically allied genera can be classified into four distinct clades. These include the deciduous genus *Pourthiaea* and three evergreen genera: *Photinia*, *Stranvaesia*, and *Weniomeles*, as redefined in recent studies (Liu et al. 2019; Jin et al. 2023). This study undertook the most extensive taxonomic sampling to date and inferred a well-supported phylogenetic backbone of these four genera in the framework of the tribe Maleae based on the whole plastome. This finding suggests that the evergreen genus *Photinia* is closely related to a clade combining *Heteromeles* and *Cotoneaster*, the deciduous genus *Pourthiaea* is sister to the transatlantic group of *Malus*, and *Weniomeles* is phylogenetically nested within *Stranvaesia*. Contrarily, the recent transcriptome-based nuclear phylogeny (Zhang et al. 2023) suggested an alternative phylogenetic relationship, positioning *Photinia* alongside *Heteromeles*, and *Pourthiaea* sister to a group of genera characterized by multiple ovules, including *Chaenomeles*, *Cydonia*, and *Pseudocydonia*. It is noteworthy that Zhang et al. (2023) did not include any species of *Stranvaesia* and *Weniomeles* in their sampling. Addressing this sampling gap, the phylogenomic investigation by Jin et al. (2023) elucidated the close phylogenetic relationship between *Stranvaesia* and *Weniomeles*, which, in turn, collectively form a sister clade to a group comprising *Photinia* and *Cotoneaster*. The significant cytonuclear discordance revealed the potential reticulation events in the origin of these genera.

Nomenclaturally, the genus *Pourthiaea* has been thoroughly evaluated, including 213 names in a comprehensive checklist (Lou et al. 2022). In this study, we focus on the remaining three evergreen genera: *Photinia*, *Stranvaesia*, and *Weniomeles*. We aim to conduct an in-depth nomenclature assessment and typification for these genera. This entails a critical review of the existing names, verification of their validity according to botanical nomenclature rules, and clarification of type specimens for each taxon. Our analysis aims to provide clarity and precision in the taxonomic classification of these genera, contributing to a better understanding of their evolutionary relationships and aiding in their accurate identification and study in botanical and ecological research.

Photinia **Lindl., Bot. Reg. 6: t. 491. 1820., nom. cons.**
Common name: 石楠属 (Chinese name); pinyin (spelled as sounds in Chinese): shi nan shu

Type. *Photinia serrulata* Lindl., nom. illeg. ≡ *Crataegus glabra* Thunb. ≡ *Photinia glabra* (Thunb.) Franch. & Sav., type conserved by Nesom and Gandhi (2009).

Remark. Approximately 27 species and 10 varieties are found across East, South, and Southeast Asia.

1. ***Photinia anlungensis*** **T.T.Yu, Acta Phytotax. Sin. 8: 228. 1963.**
Common name: 安龙石楠 (Chinese name); pinyin (spelled as sounds in Chinese): an long shi nan

≡ *Pyrus anlungensis* (T.T.Yu) M.F.Fay & Christenh., Global Fl. 4: 95. 2018.

Type. China. Guizhou: Anlong, 15 June 1960, *C.S. Chang & Y.T. Chang 5359* (holotype: PE [barcode 00061327!]; isotype: HGAS [barcode 021155!]).

Distribution. China (Guizhou).

2. ***Photinia beckii*** **C.K.Schneid., Ill. Handb. Laubholzk. [C.K.Schneider] 1: 707. 1906.**
Common name: 椭圆叶石楠 (Chinese name); pinyin (spelled as sounds in Chinese): tuo yuan ye shi nan

≡ *Pyrus beckii* (C.K.Schneid.) M.F.Fay & Christenh., Global Fl. 4: 98. 2018.

Type. China. Yunnan: Mengtze, woods, 5500 feet, *A. Henry 9795A* (lectotype, designated by Pathak et al. (2021: 39): E [barcode E00010996!]; isolectotypes: A [barcode 00045594!], US [barcode 00097493!]). Image of lectotype available from https://plants.jstor.org/stable/10.5555/al.ap.specimen.e00010996.

Distribution. China (Yunnan).

3. ***Photinia berberidifolia*** **Rehder & E.H.Wilson, Pl. Wilson. (Sargent) 1(2): 191. 1912.**
Common name: 小檗叶石楠 (Chinese name); pinyin (spelled as sounds in Chinese): xiao bo ye shi nan

≡ *Pyrus berberidifolia* (Rehder & E.H.Wilson) M.F.Fay & Christenh., Global Fl. 4: 98. 2018.

Type. China. Sichuan, Tung Valley, May 1904, *E.H. Wilson 3508* (holotype: A [barcode 00038561!]; isotypes: A [barcode 000385610!], K [barcode K000758250!]). Image of holotype available from https://plants.jstor.org/stable/10.5555/al.ap.specimen.a00038561.

Distribution. China (Sichuan).

4. *Photinia chihsiniana* K.C.Kuan, Acta Phytotax. Sin. 8(3): 227. 1963.
Common name: 临桂石楠 (Chinese name); pinyin (spelled as sounds in Chinese): lin gui shi nan

≡ *Pyrus chihsiniana* (K.C.Kuan) M.F.Fay & Christenh., Global Fl. 4: 100. 2018.

Type. China. Guangxi: Lingui, 8 May 1950, *C.S. Chung 808097* (holotype: IBK [barcode IBK00062054!]; isotypes: GAC [barcode GAC0010558], IBSC [barcode 0004364!], PE [barcode 00299791!]). ibidem, 22 November 1953, *C.F. Liang 31096* (paratypes: GAC [barcode GAC0010567!], IBSC [barcode 0004332!], KUN [barcode 607115!], PE [barcode 00299793!], SYS [barcode sys00075317!]). Lingui, Yanshan, 20 April 1951, *C.S. Chung 808829* (paratypes: GAC [barcode GAC0010559!], IBSC [barcode 0318308!], PE [barcode 00299794!]). ibidem, *C.S. Chung 808871* (paratypes: GAC [barcode GAC0010557!], IBK [barcode IBK00062057!, IBK00062205!], IBSC [barcode 0318305!, 0318306!]). ibidem, 23 July 1950, *C.S. Chung 808679* (paratypes: GAC [barcode GAC0010573!], IBK [barcode IBK00062224!], IBSC [barcode 0318307!]). Pinglou, 23 April 1958, *Z.Z. Chen 52327* (paratypes: IBK [barcode IBK00062052!, IBK00190808!], IBSC [barcode 0335042!], KUN [barcode 607345!]). Guilin, 8 July 1937, *W.T. Tsang 27773* (paratypes: IBSC [barcode 0318304!], SYS [barcode SYS00074928!]). ibidem, August 1937, *W.T. Tsang 27992* (paratypes: IBSC [barcode 0318303!], SYS [barcode sys00095740!]). ibidem, 29 March 1948, *C.N. Tang 13423* (paratype: IBK [barcode IBK00062056!]).

Distribution. China (Guangxi and Hunan).

5. *Photinia chingiana* Hand.-Mazz., Sinensia 2: 125. 1932.
Common name: 宜山石楠 (Chinese name); pinyin (spelled as sounds in Chinese): yi shan shi nan

≡ *Pyrus chingiana* (Hand.-Mazz.) M.F.Fay & Christenh., Global Fl. 4: 100. 2018.

Type. China. Kwangsi (Guangxi, Yishan): Bui-tung, Nibai ad conf. prov. Kweichou, 1000 m, in silvis apertis vel ripis rivorum, raro, 27 June 1928, *R.C. Ching 6244* (lectotype, designated by Pathak et al. (2021: 39): NY [barcode NY00436112!; isolectotypes: IBSC [barcode 0004365!], NAS [barcode NAS00071252!, NAS00071253!], PE [barcode 00026318!]). Image of lectotype available from https://plants.jstor.org/stable/10.5555/al.ap.specimen.ny00436112.

Distribution. China (Guangxi and Guizhou).

5a. *Photinia chingiana* var. *chingiana*
Common name: 宜山石楠 (原变种) (Chinese name)

= *Photinia austroguizhouensis* Y.K.Li, Bull. Bot. Res., Harbin 6(4): 107. 1986. Type: CHINA. Guizhou: Libo, *M.Z. Yang et al. 810333* (holotype: HGAS; isotype: PE [barcode 01432751!]).

= *Photinia simplex* Y.K.Li & X.M.Wang, Bull. Bot. Res., Harbin 8(3): 133. 1988. Type: CHINA. Guizhou: Sandu County, Yaorenshan, *Y.K. Li 10173* (holotype: HGAS; isotype: PE [barcode 01432750!]).

Distribution. China (Guangxi and Guizhou).

5b. *Photinia chingiana* var. *lipingensis* (Y.K.Li & M.Z.Yang) L.T.Lu & C.L.Li, Acta Phytotax. Sin. 38(3): 277. 2000.

Common name: 黎平石楠 (Chinese name); pinyin (spelled as sounds in Chinese): li ping shi nan

≡ *Photinia lipingensis* Y.K.Li & M.Z.Yang, Bull. Bot. Res., Harbin 8(3): 134. 1988.

Type. China. Guizhou: Liping, Zhongchao, October 1987, *D.F. Huang 714* (holotype: HGAS; isotype: PE [barcode 01432752!]).

Distribution. China (Guizhou).

6. *Photinia chiuana* Z.H.Chen, Feng Chen & X.F.Jin, J. Hangzhou Univ., Nat. Sci. Ed. 20(1): 32. 2021.

Common name: 裘氏石楠 (Chinese name); pinyin (spelled as sounds in Chinese): qiu shi shi nan

Type. China. Zhejiang: Qujiang, Hunan Town, Poshi Village, Bijiashanzhuang, alt. 140 m, 20 May 2019, *Z.H. Chen, L. Chen, & Q.S. Lin QJ19052001* (holotype: ZM; isotype: ZM).

Distribution. China (Zhejiang).

7. *Photinia crassifolia* H.Lév., Flore du Kouy-Tchéou 349. 1915.

Common name: 厚叶石楠 (Chinese name); pinyin (spelled as sounds in Chinese): hou ye shi nan

≡ *Pyrus crassifolia* (H.Lév.) M.F.Fay & Christenh., Global Fl. 4: 101. 2018.

= *Photinia cavaleriei* H.Lév., Repert. Spec. Nov. Regni Veg. 11: 66. 1912. later homonym. non H.Lév., Repert. Spec. Nov. Regni Veg. 4: 334. 1907. Type: CHINA. Guizhou: Tin-fan (= Huishui), June 1909, *J. Cavalerie 3571* (holotype: E [barcode E00011309!]). Image of holotype available from https://plants.jstor.org/stable/10.5555/al.ap.specimen.e00011309.

= *Photinia crassifolia* var. *denticulata* Cardot, Notul. Syst. (Paris) 3: 372. 1918. Type: CHINA. Guizhou, San-chouen (= Anshun), 1910, *J. Cavalerie 3571-pp* (lectotype, designated by Pathak et al. (2021: 39): P [barcode P02143157!]; isotype: P [barcode P02143156!]). Image of lectotype available from https://plants.jstor.org/stable/10.5555/al.ap.specimen.p02143157.

Type. China. Guizhou: Gan-chouen (= Anshun), April 1912, *J. Cavalerie 3571* (lectotype, designated by Pathak et al. (2021: 39): E [barcode E00284677!];

isolectotype: P [barcode P02143158!]). Image of lectotype available from https://plants.jstor.org/stable/10.5555/al.ap.specimen.p02143158.

Distribution. China (Guangxi, Guizhou, and Yunnan).

8. *Photinia cucphuongensis* T.H.Nguyên & Yakovlev, Bot. Zhurn. (Moscow & Leningrad) 65(9): 1351 (in error as 1251). 1980.

Common name: 菊芳石楠 (Chinese name); pinyin (spelled as sounds in Chinese): ju fang shi nan

≡ *Pyrus cucphuongensis* (T.H.Nguyên & Yakovlev) M.F.Fay & Christenh., Global Fl. 4: 101. 2018.

Type. VIETNAM. Ninh Binh: Cuc Phuong, 29 January 1975, *A.L. Takhtadjan & N.T. Hiep 8565* (holotype: LE; isotype: HN).

Distribution. Vietnam.

9. *Photinia davidiana* (Decne.) Cardot, Bull. Mus. Natl. Hist. Nat. 25(5): 399. 1919.

Common name: 红豆果树 (Chinese name); pinyin (spelled as sounds in Chinese): hong dou guo shu

≡ *Stranvaesia davidiana* Decne., Nouv. Arch. Mus. Hist. Nat. 10: 179. 1874.

Type. CHINA. Tibet: Baoxing, Mou-Pin "now belongs to Sichuan", 1870, *A. David s.n.* (holotype: P [barcode P02143103!]). Image of holotype available from https://plants.jstor.org/stable/10.5555/al.ap.specimen.p02143103.

9a. *Photinia davidiana* var. *davidiana*

Fig. 5

Common name: 红豆果树(原变种)(Chinese name)

= *Stranvaesia integrifolia* Stapf, Hooker's Icon. Pl. 23: t. 2295. 1894. ≡ *Photinia havilandii* Stapf, Bot. Mag. 149: sub t. 9008. 1924, replacement name. Type: MALESIA. Borneo: Kinabalu, *G.D. Haviland 1071* (holotype: K [barcode K000758362!]; isotypes: K [barcode K000758363!], BM [barcode BM000602185!]). Image of holotype available from https://plants.jstor.org/stable/10.5555/al.ap.specimen.k000758362.

= *Stranvaesia henryi* Diels, Bot. Jahrb. Syst. 36(5, Beibl. 82): 52. 1905. Type: CHINA. Sichuan, February 1890, *A. Henry 8953* (lectotype, designated by Vidal (1965: 232): K [barcode K000758304!]). Image of lectotype available from https://plants.jstor.org/stable/10.5555/al.ap.specimen.k000758304.

= *Photinia niitakayamensis* Hayata, J. Coll. Sci. Imp. Univ. Tokyo 30(1): 103. 1911. ≡ *Stranvaesia niitakayamensis* (Hayata) Hayata, Icon. Pl. Formosan. 8: 33. 1919. Type: CHINA. Taiwan: Chiayi, Yushan, Mt. Niitaka, *S. Nagasawa 551* (**lectotype, designated here**: KYO [barcode KYO00022357!]; isolectotype: KYO [barcode KYO00022358!]).

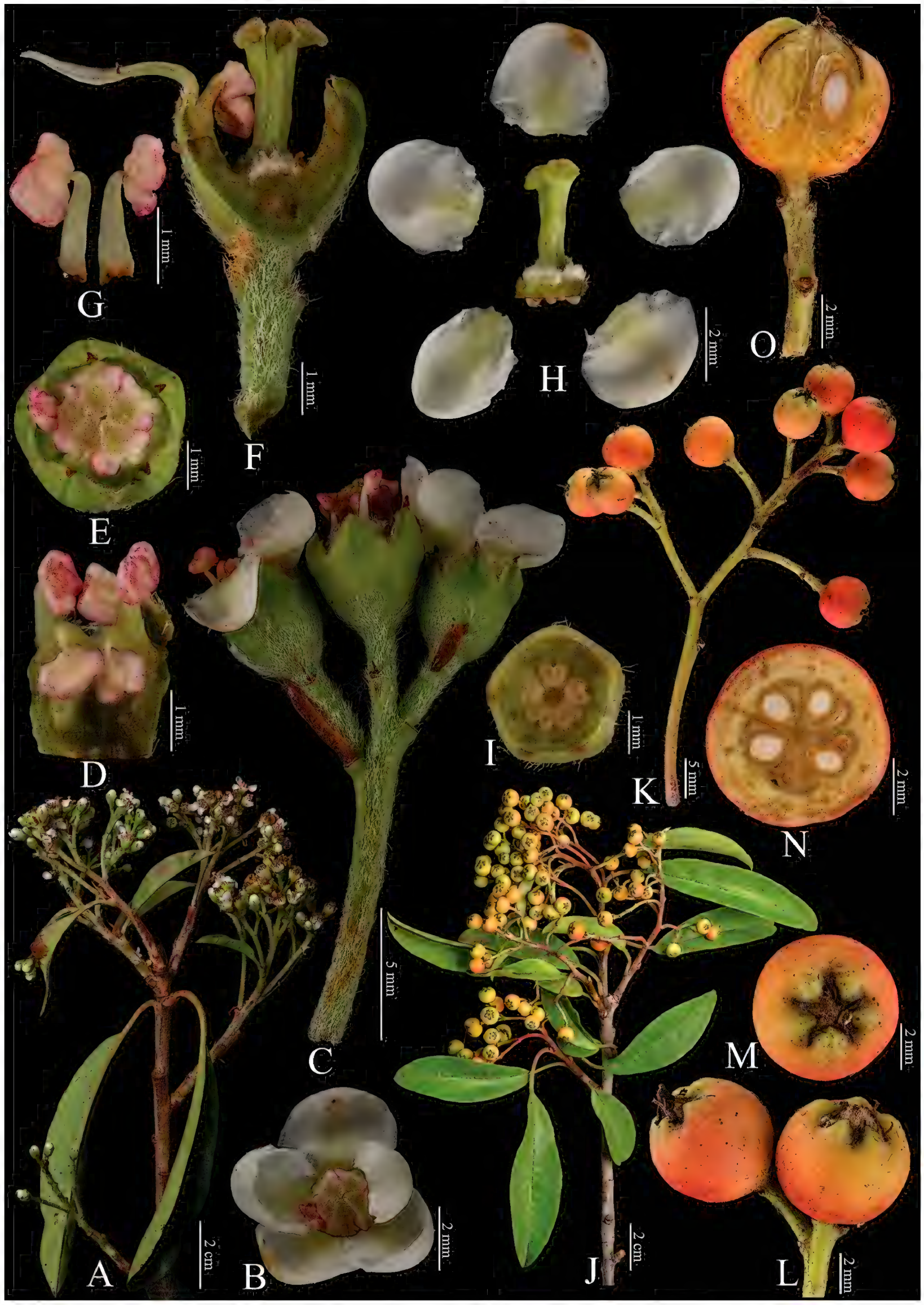


Figure 5. Fine structure of *Photinia davidiana*, encompassing various developmental stages and perspectives. **A** inflorescence branch **B** top view of a single flower **C** inflorescence branchlet **D, G** stamens **E** top view of an unopened flower **F** longitudinal section through the ovary **H** dissected flower showing internal structures **I** cross-section of the immature ovary **J** infructescence branch **K** infructescence branchlet **L** mature fruit **M** fruit, viewed from above **N** cross-sections of fruit **O** longitudinal section of fruit. The inflorescence branches (**A–I**) were collected on April 15, 2024, while the infructescence branches (**J–O**) were gathered on October 7, 2023. Yan-Li Wen was responsible for the collection of all fresh specimens at the Kunming Institute of Botany, Chinese Academy of Sciences (Yunnan, China). Furthermore, Bin-Jie Ge (Chenshan Botanical Garden, Shanghai, China) dissected and photographed all the samples.

= *Pyrus cavaleriei* H.Lév., Repert. Spec. Nov. Regni Veg. 11: 67. 1912. Type: CHINA. Guizhou: Pin-Fa, *J. Cavalerie 3569* (holotype: P [barcode P02143101!]; isotypes: A [barcode 00045576!], E [barcode E00011338!, E00284670!], P [barcode P02143100!, P02143102!]). Image of holotype available from https://plants.jstor.org/stable/10.5555/al.ap.specimen.p02143101.

= *Photinia undulata* var. *formosana* Cardot, Notul. Syst. (Paris) 3: 372. 1914. ≡ *Photinia davidiana* var. *formosana* (Cardot) H.Ohashi & Iketani, J. Jap. Bot. 69(1): 22. 1994. Type: CHINA. Formose (Taiwan): Arisan (Alishan), *L.U. Faurie 77* (lectotype, designated by Wang et al. (2018: 90): P [barcode P02143109!]). Image of lectotype available from https://plants.jstor.org/stable/10.5555/al.ap.specimen.p02143109.

= *Photinia davidiana* f. *latifolia* Cardot, Bull. Mus. Natl. Hist. Nat. 25(5): 399. 1919. Type: CHINA. Yunnan: bois de Kou-toui, au-dessus de Mo-so-yn, *J.M. Delavay 3978* (holotype: L [barcode 1901178!]).

= *Stranvaesia salicifolia* Hutch., Bot. Mag. 146: t. 8862. 1920. ≡ *Stranvaesia davidiana* var. *salicifolia* (Hutch.) Rehder, J. Arnold Arbor.7(1): 29. 1926. Type: CHINA. Hupeh (Hubei): north and south of Ichang, alt. 1300–2000 m, October 1907, *E.H. Wilson 382a* (**lectotype, designated here**: A [barcode 00045607!]). Image of lectotype available from https://plants.jstor.org/stable/10.5555/al.ap.specimen.a00045607.

Distribution. China (Gansu, Guangxi, Guizhou, Hubei, Jiangxi, Shaanxi, Sichuan, Taiwan, Yunnan) and Malaysia (Kinabalu).

9b. *Photinia davidiana* var. *undulata* (Decne.) LongY.Wang, W.Guo & W.B.Liao, Phytotaxa 361(1): 91. 2018.

Common name: 波叶红豆果树 (Chinese name); pinyin (spelled as sounds in Chinese): bo ye hong dou guo shu

≡ *Stranvaesia undulata* Decne., Nouv. Arch. Mus. Hist. Nat. 10: 179. 1874. ≡ *Eriobotrya undulata* (Decne.) Franch., Pl. Delavay. 226. 1890. ≡ *Photinia undulata* Cardot, Bull. Mus. Natl. Hist. Nat. 25: 399. 1919. ≡ *Stranvaesia davidiana* var. *undulata* (Decne.) Rehder & E.H.Wilson, Pl. Wilson. 1(2): 192. 1912.

= *Stranvaesia davidiana* var. *suoxiyuensis* C.J.Qi & C.L.Peng, J. Wuhan Bot. Res. 7(3): 239. 1989. Type: CHINA. Hunan: Cili, *C.L. Peng & C.L. Long 120358* (holotype: CSFC).

Type. China. Kouy-Tcheou (= Guizhou): *Perny s.n.* (holotype: P [barcode P02143104!]; isotype: P [barcode P02143105!]). Image of holotype available from https://plants.jstor.org/stable/10.5555/al.ap.specimen.p02143104.

Distribution. China (Fujian, Guangxi, Guizhou, Hubei, Hunan, Jiangxi, Shaanxi, Sichuan, Yunnan, and Zhejiang) and Vietnam (Tonkin).

10. *Photinia glabra* (Thunb.) Franch. & Sav., Enum. Pl. Jap. 1(1): 141. 1873.

Common name: 光叶石楠 (Chinese name); pinyin (spelled as sounds in Chinese): guang ye shi nan

≡ *Crataegus glabra* Thunb., Syst. Veg., ed. 14 (J. A. Murray). 465. 1784. ≡ *Mespilus glabra* Poir., Encycl. [J. Lamarck & al.] 4(2): 446. 1798. ≡ *Photinia serrulata* Lindl., Trans. Linn. Soc. London 13: 103, t. 10 (1821), nom. illeg. ≡ *Photinia glabra* (Thunb.) Poit., Rev. Hort. (Paris) 11: 228. 1849. ≡ *Photinia glabra* (Thunb.) Maxim., Bull. Acad. Imp. Sci. Saint-Pétersbourg 19(2): 178. 1873, isonym. ≡ *Photinia glabra* (Thunb.) Decne., Nouv. Arch. Mus. Hist. Nat. 10: 140. 1874, isonym. ≡ *Pyrus thunbergii* M.F.Fay & Christenh., Global Fl. 4: 123. 2018.

= *Photinia glabra* var. *typica* Maxim., Bull. Acad. Imp. Sci. Saint-Pétersbourg 19(2): 179. 1873.

Type. Japan. Kanname, *Thunberg 11860* (syntype). ibidem, *Thunberg 11861* (syntype).

Distribution. China (Anhui, Fujian, Guangdong, Guangxi, Guizhou, Hubei, Hunan, Jiangsu, Jiangxi, Sichuan, Yunnan, and Zhejiang), Japan, Myanmar, Thailand, and Vietnam.

11. *Photinia griffithii* Decne., Nouv. Arch. Mus. Hist. Nat. 10: 142. 1874.

Fig. 6

Common name: 球花石楠 (Chinese name); pinyin (spelled as sounds in Chinese): qiu hua shi nan

≡ *Eriobotrya griffithii* (Decne.) Franch., Pl. Delavay. 1: 224. 1890. ≡ *Photinia serrulata* var. *congestiflora* Cardot, Notul. Syst. (Paris) 3: 373. 1918. nom. superfl. ≡ *Pyrus griffithiana* M.F.Fay & Christenh.; Global Fl. 4: 105. 2018.

= *Photinia glomerata* Rehder & E.H.Wilson, Pl. Wilson. (Sargent) 1(2): 190. 1912. ≡ *Pyrus glomerata* (Rehder & E.H.Wilson) M.F.Fay & Christenh., Global Fl. 4: 105. 2018. Type: CHINA. Yunnan, Szemao, *A. Henry 11716* (lectotype, selected by Vidal (1965: 226), first step; second step, designated by Wang et al. (2019: 599): E [barcode E00011310!]; isolectotypes: A [barcode 00038560!], K [barcode K000758251!], MO [barcode MO-255089!], US [barcode 00097496!]). *A. Henry 11716A* (syntypes: US [barcode 00097497!], A [barcode 00045567!, 00045568!], E [barcode E00284676!], K [barcode K000758252!], MO [barcode MO-255088!]). Image of lectotype available from https://plants.jstor.org/stable/10.5555/al.ap.specimen.e00011310.

= *Photinia franchetiana* Diels, Notes Roy. Bot. Gard. Edinburgh 5: 272. 1912. Type: CHINA. Yunnan, *G. Forrest 487* (holotype: E [barcode E00011311!]). Image of holotype available from https://plants.jstor.org/stable/10.5555/al.ap.specimen.e00011311

= *Photinia glomerata* Rehder & E.H.Wilson var. *cuneata* T.T.Yu, Acta Phytotax. Sin. 8(3): 227. 1963. Type: CHINA. Yunnan, Yung-jen, *H.T. Tsai 52879* (holotype: PE [barcode 00336359!]; isotypes: IBSC [barcode 0318765!], PE [barcode 00336360!], A [barcode 00137699!], NAS [barcode NAS00071255!], KUN [barcode 608247!]).

= *Photinia glomerata* Rehder & E.H.Wilson var. *microphylla* T.T.Yu, Acta Phytotax. Sin. 8(3): 227. 1963. Type: CHINA. Yunnan, Teng-chuan, Mt. Chih-shan, *R.C. Ching 24894* (holotype: PE [barcode 00336361!]; isotypes: PE [barcode 00336291!], KUN [barcode 607608!]).

= *Photinia semiserrata* H.Li, Fl. Dulongjian Reg. 131. 1993, nom. nud.

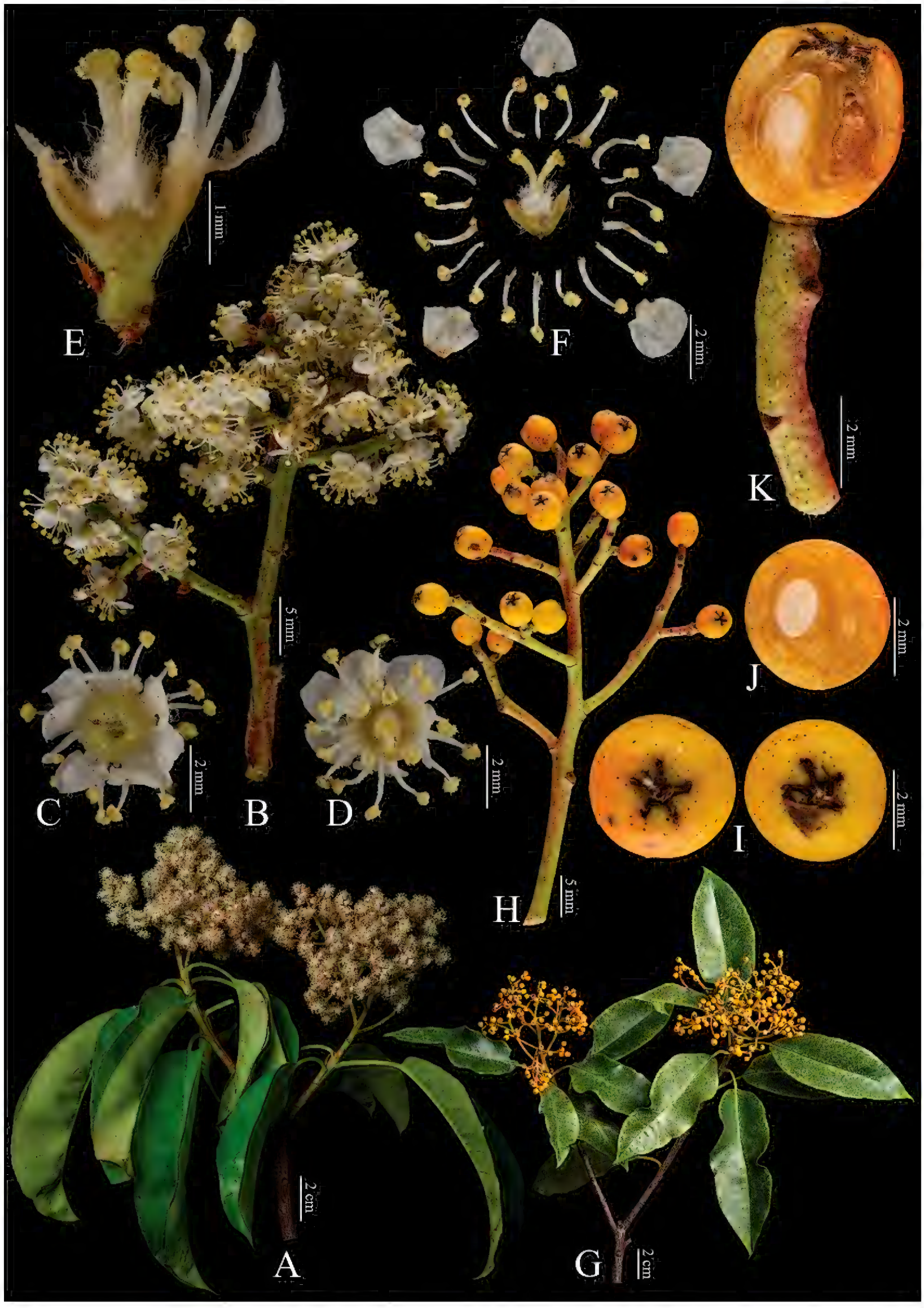


Figure 6. Fine structure of *Photinia griffithii*, encompassing various developmental stages and perspectives. **A** inflorescence branch **B** inflorescence branchlet **C** bottom perspective of an individual flower **D** top view of a single flower **E** longitudinal section through the ovary **F** dissected flower showing internal structures **G** an infructescence branch **H** infructescence branchlet **I** fruit, viewed from above **J** cross-sections of fruit **K** longitudinal section of fruit. The inflorescence branches (**A–F**) were collected on April 15, 2024, while the infructescence branches (**G–K**) were gathered on October 7, 2023. Yan-Li Wen was responsible for the collection of all fresh specimens at the Kunming Institute of Botany, Chinese Academy of Sciences (Yunnan, China). Furthermore, Bin-Jie Ge (Chenshan Botanical Garden, Shanghai, China) dissected and photographed all the samples.

Type. BHUTAN. Himalaya orientalis, 1837–1838, *Griffith 2087* (lectotype, designated by Wang et al. (2019: 599): P [barcode P02143170!]; isotypes: K [barcode K000758185!], L [barcode L0019505!], M [barcode M-0213887!]). Image of lectotype available from https://plants.jstor.org/stable/10.5555/al.ap.specimen.p02143170.

Distribution. Bhdan and China (Hubei, Sichuan, and Yunnan).

12. *Photinia integrifolia* Lindl., Trans. Linn. Soc. London 13(1): 103, t. 10. 1821.
Common name: 全缘石楠 (Chinese name); pinyin (spelled as sounds in Chinese): quan yuan shi nan

≡ *Eriobotrya integrifolia* (Lindl.) Kurz, J. Asiat. Soc. Bengal, Pt. 2, Nat. Hist. 45(4): 304. 1877. ≡ *Pyrus integrifolia* (Lindl.) M.F.Fay & Christenh., Global Fl. 4: 108. 2018.

Type. NEPAL. 7 November 1821, *Wallich 669* (lectotype, selected by Kalkman (1973: 419) 'holotype', first step; second step, designated by Pathak et al. (2019: 184): K [barcode K001111555!]; isolectotypes: E [barcode E00011312!], GH [barcode 00045579!], GZU [barcode 000283019!], K [barcode K000758314!, K001111556!], L [barcode L0019506!, L0019507!], P [barcode P02143206!], NY [barcode 00436120!]). Image of lectotype available from https://plants.jstor.org/stable/10.5555/al.ap.specimen.k001111555.

Distribution. Bangladesh, Bhutan, China (Guangxi, Guizhou, Tibet, Yunnan), India (Arunachal Pradesh, Assam, Manipur, Meghalaya, Sikkim, Tamil Nadu, Uttar Pradesh, West Bengal), Indonesia (Gunung Ulu Kali, Pahan, Java, Lesser Sunda Isl.), Laos, Myanmar (Chin, Kachin, Mandalay, Sagaing), Nepal, Thailand, and Vietnam.

12a. *Photinia integrifolia* var. *integrifolia*
Fig. 7
Common name: 全缘石楠(原变种)(Chinese name)

= *Pyrus integerrima* Wall. ex D.Don, Prodr. Fl. Nepal. 237. 1825, nom. illeg. superfl. ≡ *Photinia integerrima* (Wall. ex D.Don) N.P.Balakr., Fl. Jowai 1: 191. 1981.

= *Photinia scandens* Stapf, Bot. Mag. 149: sub t. 9008. 1924. ≡ *Stranvaesia scandens* (Stapf) Hand.-Mazz., Symb. Sin. 7(3): 483. 1933. Type: CHINA. Yunnan: Shweli-Salwin divide, *G. Forrest 9329* (holotype: E [barcode E00011339!]; isotypes: K [barcode K000758309!], IBSC [barcode 0318894!]). Image of holotype available from https://plants.jstor.org/stable/10.5555/al.ap.specimen.e00011339.

= *Photinia myriantha* Merr., Brittonia 4: 82. 1941. Type: MYANMAR. Adung Valley, *F.K.Ward 9276* (holotype: A [barcode 00026802!]); Ngawchang Valley, near Black Rock, *F.K. Ward 359* (paratype: NY [barcode 00436121!]). Image of holotype available from https://plants.jstor.org/stable/10.5555/al.ap.specimen.a00026802.

= *Photinia integrifolia* var. *yunnanensis* T.T.Yu, Acta Phytotax. Sin. 8(3): 229. 1963. Type: CHINA. Yunnan: Wei-si, alt. 2500 m, *K.M. Feng 4167* (holotype:

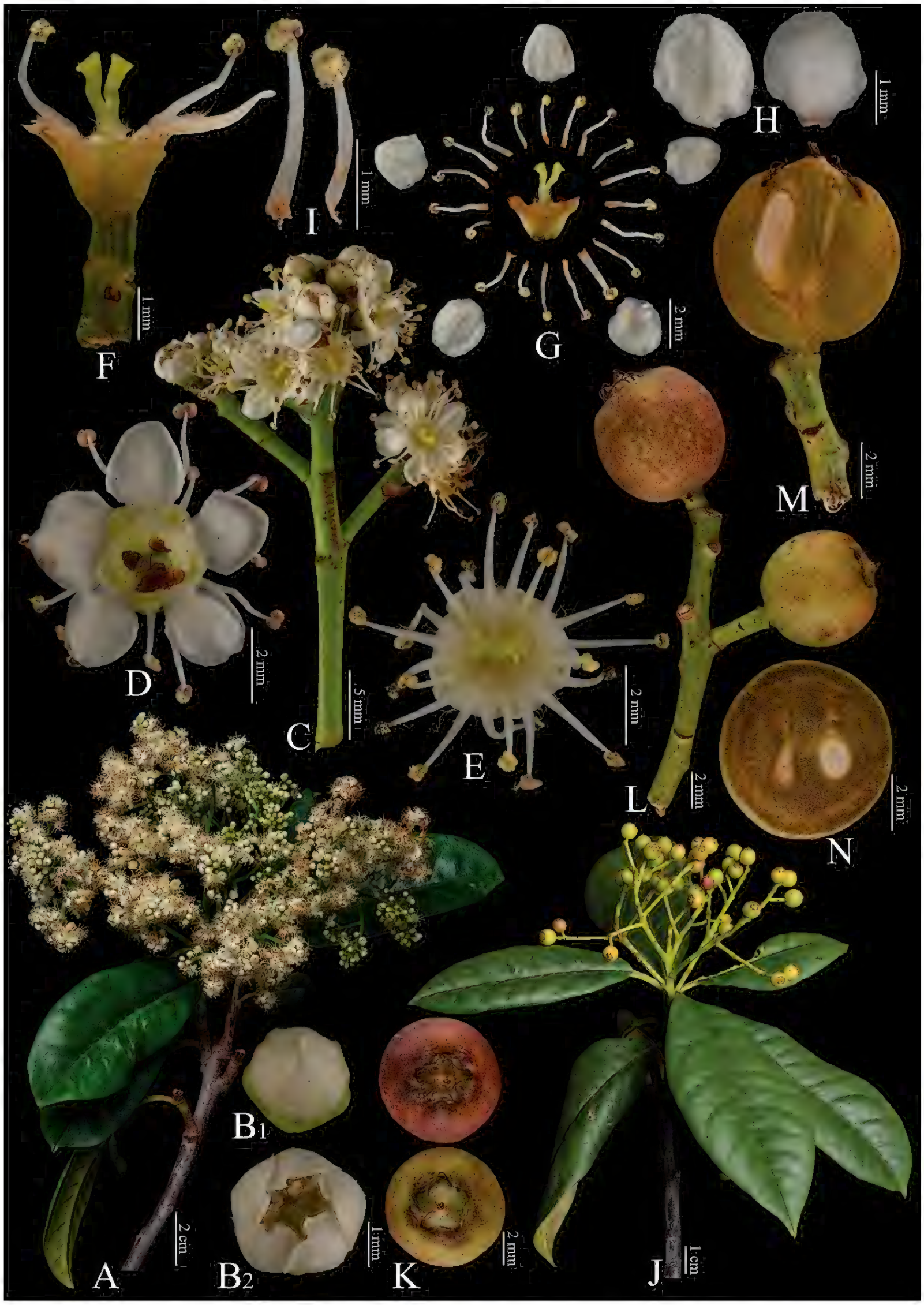


Figure 7. Fine structure of *Photinia integrifolia*, encompassing various developmental stages and perspectives. **A** inflorescence branch **B1** top view of an unopened flower **B2** top view of an opening flower **C** inflorescence branchlet **D** bottom perspective of an individual flower **E** top view of a single flower with the absence of petals **F** longitudinal section through the ovary **G** dissected flower showing internal structures **H** petals **I** stamens **J** an infructescence branch **K** fruit, viewed from above **L** infructescence branchlet **M** longitudinal section of fruit **N** cross-sections of fruit. The inflorescence branches (**A–I**) were collected on April 15, 2024, while the infructescence branches (**J–N**) were gathered on October 7, 2023. Yan-Li Wen was responsible for the collection of all fresh specimens at the Kunming Institute of Botany, Chinese Academy of Sciences (Yunnan, China). Furthermore, Bin-Jie Ge (Chenshan Botanical Garden, Shanghai, China) dissected and photographed all the samples.

PE [barcode 00004602!]; isotypes: PE [barcode 00336524!, 00336554!], KUN [barcode 607497!]). Kung-shan (Champutung) alt. 1600–1800 m, *K.M. Feng 8153* (paratypes: PE [barcode 00336477!, 00336552!]).

Distribution. Bangladesh, Bhutan, China (Guangxi, Guizhou, Tibet, Yunnan), India, Indonesia, Myanmar, Nepal, Thailand, and Vietnam.

12b. *Photinia integrifolia* var. *flavidiflora* (W.W.Sm.) J.E.Vidal, Adansonia, n.s. 5: 227. 1965.

Common name: 黄花全缘石楠 (Chinese name); pinyin (spelled as sounds in Chinese): huang hua quan yuan shi nan

≡ *Photinia flavidiflora* W.W.Sm., Notes Roy. Bot. Gard. Edinburgh 10: 59. 1917.

Type. China. Yunnan: Mingkwong Vally, November 1912, *G. Forrest 9221* (lectotype, designated by Vidal (1965: 227): E [barcode E00011313!]; isolectotype: A [barcode 00026742!]). Hills to the N. W. Tengyueh, *G. Forrest 9294* (syntypes: BM [barcode BM000602131!], E [barcode E00072939!], K [barcode K000758267!], A [barcode 00026743!]). Divide between the Tengyueh and Shweli Valleys, *G. Forrest 7901* (syntype). Image of lectotype available from https://plants.jstor.org/stable/10.5555/al.ap.specimen.e00011313.

Distribution. China (Yunnan) and Myanmar (Kachin).

12c. *Photinia integrifolia* var. *notoniana* (Wight & Arn.) J.E.Vidal, Addisonia 5: 227. 1965.

Common name 长柄全缘石楠 (Chinese name); pinyin (spelled as sounds in Chinese): chang bing quan yuan shi nan

≡ *Photinia notoniana* Wall. ex Wight & Arn., Prodr. Fl. Ind. Orient. 1: 302. 1834. ≡ *Eriobotrya notoniana* (Wall. ex Wight & Arn.) Kurz, Prelim. Rep. Forest Pegu App. B. 48. 1875.

= *Photinia eugenifolia* Lindl., Edwards's Bot. Reg. 23: t. 1956. 1837. ≡ *Photinia notoniana* var. *eugenifolia* Hooker, Fl. Brit. India 2: 381. 1878. Type: INDIA. Pundua, 1832, *Wallich 670B* (lectotype, designated by Vidal (1965: 226): K [barcode K001111558!]). Image of lectotype available from https://plants.jstor.org/stable/10.5555/al.ap.specimen.k001111558.

= *Photinia micrantha* Decne., Nouv. Arch. Mus. Hist. Nat. 10: 143. 1874. ≡ *Photinia notoniana* f. *micrantha* (Decne.) Koord. & Valeton, Bijdr. Boomsoort. Java 5: 364. 1900. Type: INDIA / BABGLADESH. Bengalia orientalis, *Griffith 2098* (lectotype, selected by Vidal (1965: 227), first step; second step, designated by Kalkman (1973: 420): K [barcode K000758325!]; isolectotype: P [barcode P02143138!]). Image of lectotype available from https://plants.jstor.org/stable/10.5555/al.ap.specimen.k000758325.

= *Photinia notoniana* var. *ceylanica* Hook.f., Fl. Brit. India 2: 381. 1878. Type: INDIA. *G. Walker s.n.* (lectotype, designated by Pathak et al. (2019: 185): K [barcode K000758326!]). Image of lectotype available from https://plants.jstor.org/stable/10.5555/al.ap.specimen.k000758326.

= *Photinia notoniana* var. *macrophylla* Hook.f., Fl. Brit. India 2: 381. 1878. Type: INDIA. Khasia Hills, *J.D. Hooker & T. Thomoson s.n.* (lectotype, designated by Pathak et al. (2019: 185): K [barcode K000758321!]; isolectotypes: K [barcode K000758319!, K000758322!, K000758323!]). Image of lectotype available from https://plants.jstor.org/stable/10.5555/al.ap.specimen.k000758321.

= *Photinia sambuciflora* W.W.Sm., Notes Roy. Bot. Gard. Edinburgh 10: 60. 1917. Type: CHINA. Yunnan: Hills to the north of Tengyueh, *G. Forrest 9722* (**lectotype**, selected by Vidal (1965: 227), first step; **second step, designated here**: E [barcode E00011314!]; isolectotypes: HBG [barcode HBG-511070!], BM [barcode BM000602132!]); Shweli-Salween divide, *G. Forrest 12293* (syntypes: BM [barcode BM000602133!], E [barcode E00072952!], K [barcode K000758268!]). Image of lectotype available from https://plants.jstor.org/stable/10.5555/al.ap.specimen.e00011314.

Type. India. Nilghiris, *Wight 1014* (lectotype, selected by Vidal (1965: 226) 'holotype': K [barcode K000758317!]; isolectotypes: E [barcode E00011315!], P [barcode P02143139!]). Image of lectotype available from https://plants.jstor.org/stable/10.5555/al.ap.specimen.k000758317.

Distribution. China (Yunnan), India, and Laos.

12d. *Photinia integrifolia* var. *sublanceolata* Miq., Fl. Ned. Ind.1(1): 387. 1855.
Common name: 狭叶全缘石楠 (Chinese name); pinyin (spelled as sounds in Chinese): xia ye quan yuan shi nan

= *Photinia integrifolia* var. *subdenticulata* Miq., Fl. Ned. Ind.1(1): 387. 1855. Type: INDONESIA. Java: Mount Prahu, *T. Horsfield 1135* (lectotype, designated by Kalkman (1973: 420) 'holotype': K [barcode K000758360!]; isolectotype: BM [barcode BM000602182!]). Image of lectotype available from https://plants.jstor.org/stable/10.5555/al.ap.specimen.k000758360.

= *Photinia dasythrysa* Miq., Fl. Ned. Ind. 1(1): 387. 1855. ≡ *Photinia integrifolia* var. *dasythrysa* (Miq.) J.E.Vidal, Adansonia 5: 227. 1965. Type: INDONESIA. Sumatra: Sunda-eilanden, *Miquel s.n.* (holotype: U [barcode U0123984!]). Image of holotype available from https://plants.jstor.org/stable/10.5555/al.ap.specimen.u0123984.

= *Photinia notoniana* var. *angustata* Blume ex K.Koch, Ann. Mus. Bot. Lugduno-Batavi 1: 250. 1864, nom. nud.

= *Photinia blumei* Decne., Nouv. Arch. Mus. Hist. Nat. 11: 142. 1874. Type: INDONESIA. Java, mons Malabar, 19 October 1861, *Anderson 83* (lectotype, designated by Vidal (1965: 227): P [barcode P02143205!]; isolectotype: K [barcode K000758361!]); *Wight 923* (syntype: P [barcode P02143136!]); *Wight 924* (syntype: P [barcode P02143137!]). Image of lectotype available from https://plants.jstor.org/stable/10.5555/al.ap.specimen.p02143205.

= *Photinia notoniana* f. *grandiflora* Koord. & Valeton, Bijdr. Boomsoort. Java 5: 364. 1900. Type: not designated.

= *Photinia notoniana* f. *vulgaris* Koord. & Valeton, Bijdr. Boomsoort. Java 5: 364. 1900. Type: not designated.

Type. INDONESIA. Java: Surakarta, *T. Horsfield 432* (lectotype, designated by Kalkman (1973: 420) 'holotype': K [barcode K000758357!]; isolectotype: BM [barcode BM000602183!]). Image of lectotype available from https://plants.jstor.org/stable/10.5555/al.ap.specimen.k000758357.

Distribution. Indonesia (Java and Sumatra).

13. *Photinia lanuginosa* T.T.Yu, Acta Phytotax. Sin. 8(3): 227. 1963.

Fig. 8

Common name: 绵毛石楠 (Chinese name); pinyin (spelled as sounds in Chinese): mian mao shi nan

≡ *Pyrus atalantae* M.F.Fay & Christenh., Global Fl. 4: 96. 2018.

Type. CHINA. Hunan, Mt. Xuefengshan, *C.T. Li 1882* (holotype: PE [barcode 00026329!]; isotype: IBSC [barcode 0344338!], PE [barcode 00004601!]).

Distribution. China (Hunan).

14. *Photinia lindleyana* Wight & Arn., Prodr. Fl. Ind. Orient. 1: 302. 1834.

Common name: 川滇石楠 (Chinese name); pinyin (spelled as sounds in Chinese): chuan dian shi nan

≡ *Photinia serrulata* var. *lindleyana* (Wight & Arn.) Wenz., Linnaea 38: 94. 1873. ≡ *Pyrus lindleyana* (Wight & Arn.) M.F.Fay & Christenh., Global Fl. 4: 110. 2018.

= *Photinia lindleyana* var. *tomentosa* Gamble, Fl. Madras 1(3): 445. 1919. ≡ *Photinia serratifolia* var. *tomentosa* (Gamble) Vivek. & B.V.Shetty, Bull. Bot. Surv. India 23(3–4): 256. 1983. ≡ *Pyrus lindleyana* var. *tomentosa* (Gamble) K.S. Kumar & Arum., Indian Forester 148(1): 115. 2022. Type: INDIA. Tamil Nadu, Nilgiris District, between Bangi Tappal and Sispara, alt. 7500 ft. ASL, May 1889, *J.S. Gamble 20638* (lectotype, designated by Kumar and Arumugam (2022: 115): MH [barcode MH00234090!]).

Type. INDIA. Peninsula Ind. orientalis, *Wight 1012* (lectotype, selected by Kalkman (1973: 424), first step; second step, designated by Kumar and Arumugam (2022: 117): K [barcode K000758313!]; isolectotypes: BM [barcode BM000602140!], E [barcode E00011327!]). *Wight 1013* (syntypes: BM [barcode BM000602139!], E [barcode E00174590!, E00174591!], GZU [barcode GZU000283017!], K [barcode K000758312!], P [barcode P02143117!]). Image of lectotype available from https://plants.jstor.org/stable/10.5555/al.ap.specimen.k000758313.

Distribution. China (Sichuan and Yunnan) and India (Kerala and Tamil Nadu).

14a. *Photinia lindleyana* var. *lindleyana*

Common name: 川滇石楠 (原变种) (Chinese name)

Distribution. China (Sichuan and Yunnan) and India (Kerala and Tamil Nadu).

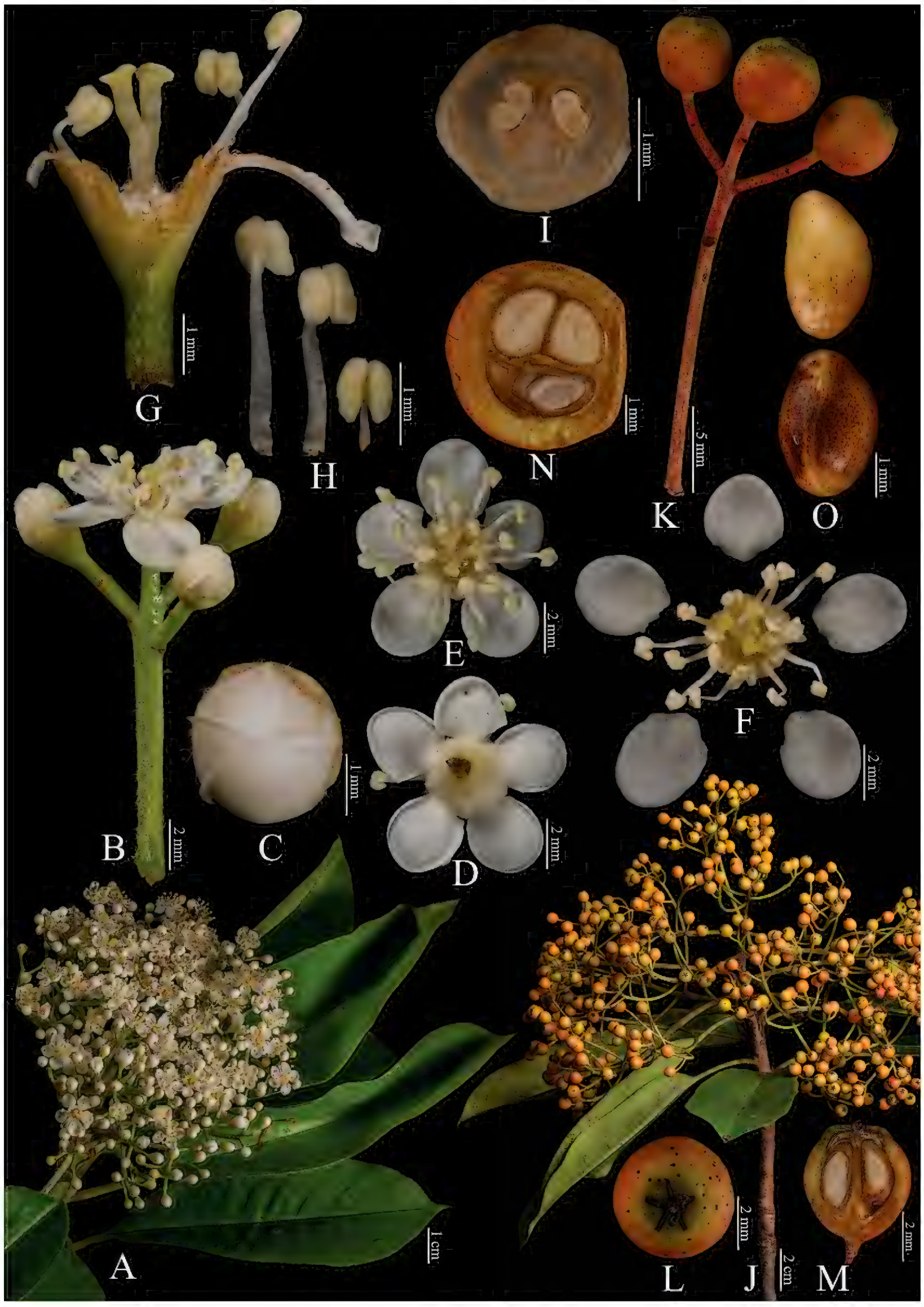


Figure 8. Fine structure of *Photinia lanuginosa*, encompassing various developmental stages and perspectives. The inflorescence branches, depicted in **A–I**, include **A** whole branch **B** branchlet **C** top view of an unopened flower **D** bottom perspective of an individual flower **E** top view of a single flower **F** dissected flower showing internal structures **G** longitudinal section through the ovary **H** stamens **I** cross-section of the immature ovary. These were collected on April 3, 2024. The infructescence branches, shown in **J–O**, comprise: **J** whole branch **K** branchlet **L** top view of a developing fruit **M** longitudinal section of the fruit **N** cross-sections of the fruit **O** seed. These were collected on November 29, 2023. All fresh specimens were collected by Ting Wang at the Hangzhou Botanical Garden, Zhejiang, China. Additionally, Bin-Jie Ge from the Chenshan Botanical Garden in Shanghai, China, dissected and photographed all samples.

14b. *Photinia lindleyana* var. *yunnanensis* Cardot, Notul. Syst. (Paris) 3: 374. 1918.

Common name: 滇石楠 (Chinese name); pinyin (spelled as sounds in Chinese): dian shi nan

Type. China. Yunnan: ao Kouy Chan près My Li, 1906, *F. Ducloux & P. Ngeou 4242-pp* (**lectotype, designated here**: P [barcode 02143143!]; isolectotype: P [barcode 02143144!]). Yunnan: Lan argy tsin, près Lou lan, 17 April 1908, *F. Ducloux & J.B. Lo 5936* (syntype: P [barcode P02143144!]).

Distribution. China (Yunnan).

15. *Photinia lochengensis* T.T.Yu, Acta Phytotax. Sin. 8(3): 226. 1963.

Common name: 罗城石楠 (Chinese name); pinyin (spelled as sounds in Chinese): luo cheng shi nan

≡ *Pyrus lochengensis* (T.T.Yu) M.F.Fay & Christenh., Global Fl. 4: 110. 2018.

Type. China. Guangxi: Lo-cheng (=Luocheng), *W. Chen 84410* (holotype: IBSC; isotypes: PE [barcode 00004611!, 01790013!]). Note A.

Distribution. China (Guangxi).

Note A. In the protologue, Yu and Kuan (1963) designated the type specimen as being deposited in the herbarium "HC", which they referenced as "Herb. Inst. Austro-Sin. Acad. Sin. Canton". The correct standard name for this institute is the South China Botanical Garden (IBSC). However, we could not locate any specimens from this collection in IBSC. Instead, we found two isotype sheets at the PE herbarium.

16. *Photinia loriformis* W.W.Sm., Notes Roy. Bot. Gard. Edinburgh 10: 60. 1917.

Common name: 带叶石楠 (Chinese name); pinyin (spelled as sounds in Chinese): dai ye shi nan

≡ *Pyrus loriformis* (W.W.Sm.) M.F.Fay & Christenh., Global Fl. 4: 111. 2018.

Type. China. Yunnan, Yunnanfu (=Kunming), *E.E. Maire 1118* (**lectotype, designated here**: E [barcode E00011317!]; isolectotypes: A [barcode A00045580!], K [barcode K000758253!]). *E.E. Maire 1117* (syntype: E [barcode E00285982!]), *E.E. Maire 1755* (syntype: E [barcode E00285984!]), *E.E. Maire 2099* (syntype: E [barcode E00285985!]). Note B. Image of lectotype available from https://plants.jstor.org/stable/10.5555/al.ap.specimen.e00011317.

Distribution. China (Sichuan and Yunnan).

Note B. In the protologue, the author referenced four collections collected by *E.E. Maire: 1118, 1117, 1755, and 2099*, all housed in the herbarium E. However, Smith did not designate a specific type, meaning all four collections are syntypes. A lectotypification is required (Turland et al. 2018). Upon examination of each specimen from the herbarium E, it was observed

that *E.E. Maire 1117* (barcode E00285982) and *1755* (barcode E00285984) lack flowers and fruits. *E.E. Maire 2099* (barcode E00285985) has fruits, but they are damaged by worms. As a result, *E.E. Maire 1118* (barcode E00011317), which is in good condition and has flowers, has been selected as the lectotype.

17. *Photinia maximowiczii* Decne., Nouv. Arch. Mus. Hist. Nat. 10: 143. 1874.
Common name: 琉球石楠 (Chinese name); pinyin (spelled as sounds in Chinese): liu qiu shi nan

= *Photinia wrightiana* Maxim., Bull. Acad. Imp. Sci. Saint-Pétersbourg 32: 486. 1888. Type: JAPAN. Bonin-sima, *Wright s.n.* (syntype). Liukiu, *A. Tashiro s.n.* (syntype).

Type. JAPAN. Bonin Islands, *Wright 80* (holotype: P [barcode P02143127!]; isotype: K [barcode K000758301!]). Image of holotype available from https://plants.jstor.org/stable/10.5555/al.ap.specimen.p02143127.

Distribution. Japan (Bonin Islands and Liukiu).

18. *Photinia megaphylla* T.T.Yu & L.T.Lu, Acta Phytotax. Sin. 18(4): 493. 1980.
Common name: 大叶石楠 (Chinese name); pinyin (spelled as sounds in Chinese): da ye shi nan

= *Pyrus megaphylla* (T.T.Yu & L.T.Lu) M.F.Fay & Christenh., Global Fl. 4: 111. 2018.

Type. CHINA. Tibet: Motuo, *Qingzang Exped. 74-4158* (holotype: PE [barcode 00026327!]).

Distribution. China (Tibet).

19. *Photinia microphylla* (J.E.Vidal) B.B.Liu, comb. nov.
urn:lsid:ipni.org:names:77342733-1
Common name: 少花石楠 (Chinese name); pinyin (spelled as sounds in Chinese): shao hua shi nan

= *Stranvaesia microphylla* J.E.Vidal, Notul. Syst. (Paris) 13: 300. 1949. ≡ *Pyrus pluto* M.F.Fay & Christenh., Global Fl. 4: 116. 2018.

Type. VIETNAM. Tonkin: massif du Lo Sui Tong, Près Chapa (Cha-pa and Cho-bo), 2200 m, 29 July 1926, *E. Poilane 12674* (holotype: P [barcode P02143106!]; isotypes: P [barcode P02143107!, P02143108!]). Image of holotype available from https://plants.jstor.org/stable/10.5555/al.ap.specimen.p02143106.

Distribution. Vietnam.

20. *Photinia prionophylla* (Franch.) C.K.Schneid., Repert. Spec. Nov. Regni Veg. 3: 153. 1906.

Common name: 刺叶石楠 (Chinese name); pinyin (spelled as sounds in Chinese): ci ye shi nan

≡ *Eriobotrya prionophylla* Franch. Pl. Delavay. 225, pl. 46. 1890. ≡ *Pyrus prionophylla* (Franch.) M.F.Fay & Christenh., Global Fl. 4: 116. 2018.

Type. China. Yunnan: les taillis à Kiao che tong au dessus de Kiang yn, 30 May 1888, *J.M. Delavay 3545* (lectotype, designated by Idrees et al. (2021: 167): P [barcode P03342590!]; isolectotypes: K [barcode K000758254!], LE [barcode LE01015176!]). ibidem, 28 October 1888, *J.M. Delavay 3545* (syntypes: K [barcode K000758255!]). Mo-so-yn, Lau Kong, 1 June 1884, *J.M. Delavay 1077* (syntypes: A [barcode 00026479!, 00026749!, 00026750!], P [barcode P02143153!, P02143154!, P02143155!]). Image of lectotype available from https://plants.jstor.org/stable/10.5555/al.ap.specimen.k000758254.

Distribution. China (Sichuan and Yunnan).

20a. *Photinia prionophylla* var. *prionophylla*

Common name: 刺叶石楠 (原变种) (Chinese name)

Distribution. China (Sichuan and Yunnan).

20b. *Photinia prionophylla* var. *nudifolia* Hand.-Mazz., Symb. Sin. 7(3): 480. 1933.

Common name: 无毛刺叶石楠 (变种) (Chinese name); pinyin (spelled as sounds in Chinese): wu mao ci ye shi nan

Type. China. Yunnan: Yunnanfu (= Kunming), Prope vicum Hsiao-Magai ad septentr. urbis Yünnanfu, 25°26’ lat., in regionis calide temperatae inte Döge et Hsiaodjiadsum. 1800 m. 8 March 1914, *H. Handel-Mazzetti 404* (holotype: WU [barcode 0059448!]).

Distribution. China (Yunnan).

21. *Photinia prunifolia* (Hook. & Arn.) Lindl., Edwards's Bot. Reg. 23: sub t. 1956. 1837.

Fig. 9

Common name: 桃叶石楠 (Chinese name); pinyin (spelled as sounds in Chinese): tao ye shi nan

≡ *Photinia serrulata* var. *prunifolia* Hook. & Arn., Bot. Beechey Voy. 4: 185. 1833. ≡ *Pyrus uranus* M.F.Fay & Christenh., Global Fl. 4: 124. 2018.

= *Photinia melanostigma* Hance, J. Bot. 20: 5. 1882. Type: CHINA. Guangdong, North River, March 1881, *B.C. Henry 21691* (holotype: BM [barcode

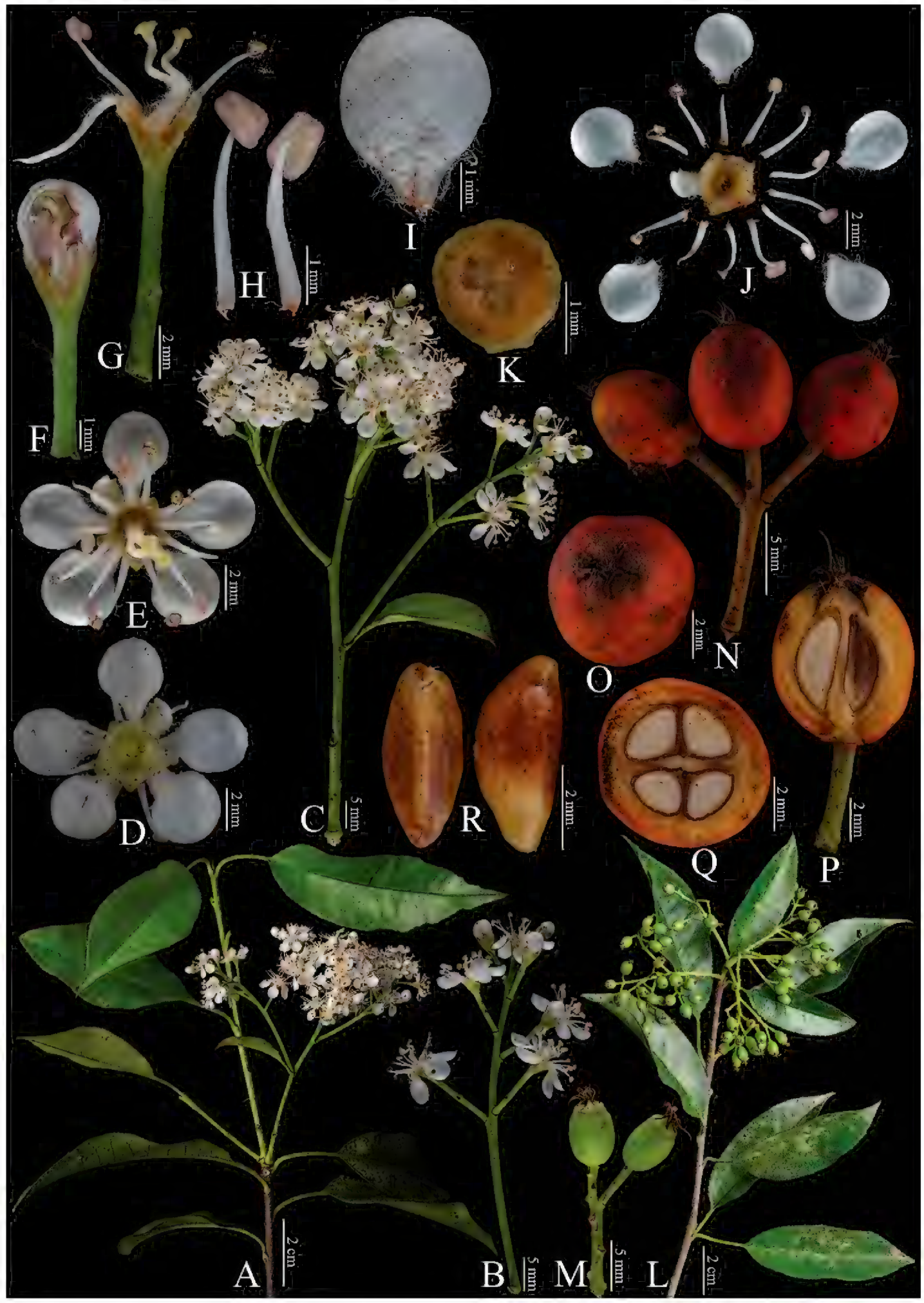


Figure 9. Fine structure of *Photinia prunifolia*, encompassing various developmental stages and perspectives. **A** inflorescence branch **B, C** inflorescence branchlet **D** bottom perspective of an individual flower **E** top view of a single flower **F, G** longitudinal section through the ovary **H** stamens **I** petals **J** dissected flower showing internal structures **K** cross-section of the immature ovary **L** an infructescence branch **M, N** comparative fruit in both inmature and mature states **O** fruit, viewed from above **P** longitudinal section of fruit **Q** cross-sections of fruit **R** fully matured seed. The inflorescence branches (**A–K**) were collected on April 13, 2024. The infructescence branches in the immature state (**L, M**) were collected on October 7, 2023, while the remaining samples (**N–R**) were gathered on November 29, 2023. Ting Wang was responsible for the collection of all fresh specimens at the Hangzhou Botanical Garden (Zhejiang, China). Furthermore, Bin-Jie Ge (Chenshan Botanical Garden, Shanghai, China) dissected and photographed all the samples.

BM000602202!]). Image of holotype available from https://plants.jstor.org/stable/10.5555/al.ap.specimen.bm000602202.

= *Photinia consimilis* Hand.-Mazz., Anz. Akad. Wiss. Wien, Math.-Naturwiss. Kl. 59: 103. 1922. Type: CHINA. Hunan: Dschaoschan (=Shaoshan), 27 October 1917, *Handel-Mazzetti 11382* (**lectotype, designated here**: WU [barcode 0059452!]). Hunan: Shaoshan, 27 October 1917, *Handel-Mazzetti 11382* (syntype: WU [barcode 0059467!]). ibidem, 16 February 1918, *Handel-Mazzetti 11472* (syntype: WU [barcode 0059453!]). Image of lectotype available from https://plants.jstor.org/stable/10.5555/al.ap.specimen.wu0059467.

= *Photinia prunifolia* var. *denticulata* T.T.Yu, Acta Phytotax. Sin. 8(3): 228. 1963. Type: CHINA. Zhejiang, Pingyang, 28 June 1959, *S.R. Zhang 5867* (holotype: PE [barcode 00026328!]; isotypes: KUN [barcode 607582!], HTC [barcode 0003151!]).

= *Photinia stapfii* Chun, nom. nud.

Type. CHINA. Macao and adjacent islands, *Beechey s.n.* (lectotype, designated by Wang et al. (2019: 68): K [barcode K000758258!]; isolectotypes: E [barcode E00369054!]). Image of lectotype available from https://plants.jstor.org/stable/10.5555/al.ap.specimen.k000758258.

Distribution. Cambodia, China (Fujian, Guangdong, Guangxi, Hainan, Hongkong, Hunan, Jiangxi, Zhejiang), and Vietnam.

22. *Photinia raupingensis* K.C.Kuan, Acta Phytotax. Sin. 8(3): 228. 1963.

Common name: 饶平石楠 (Chinese name); pinyin (spelled as sounds in Chinese): rao ping shi nan

≡ *Pyrus raupingensis* (K.C.Kuan) M.F.Fay & Christenh., Global Fl. 4: 118. 2018.

Type. CHINA. Guangdong, Raoping, Fenghuangshan, in silvis, 16 April 1931, *N.K. Chun 42691* (holotype: IBSC [barcode 0318920!]; isotypes: AU [barcode 039768!], IBK [barcode IBK00062558!, IBK00062559!], NAS [barcode NAS00374075!], PE [barcode 00020609!, 00004599!]).

Distribution. China (Guangdong and Guangxi).

23. *Photinia serratifolia* (Desf.) Kalkman, Blumea 21(2): 424. 1973.

Common name: 石楠 (Chinese name); pinyin (spelled as sounds in Chinese): shi nan

≡ *Crataegus serratifolia* Desf., Tabl. École Bot., ed. 3 (Cat. Pl. Horti Paris.) 408. 1829. ≡ *Pyrus serratifolia* (Desf.) M.F.Fay & Christenh., Global Fl. 4: 121. 2018.

Type. not designated.

23a. *Photinia serratifolia* var. *serratifolia*

Fig. 2C

Common name: 石楠 (原变种) (Chinese name)

= *Photinia glabra* var. *chinensis* Maxim., Bull. Acad. Imp. Sci. Saint-Petersbourg, sér. 3 19(2): 179. 1873. Type: CHINA. *R. Fortune A-30* (**lectotype, designated here**: P [barcode P00781062!]; isolectotypes: P [barcode P00781061!, P00781063!, P00781064!]). Note C. Image of lectotype available from https://plants.jstor.org/stable/10.5555/al.ap.specimen.p00781062.

= *Stranvaesia argyi* H.Lév., Mem. Acad. Sci. Art. Barcelona ser. 3 12: 560. 1916. Type: CHINA. *Argy s.n.* (holotype: E [barcode E00011323!]). Image of holotype available from https://plants.jstor.org/stable/10.5555/al.ap.specimen.e00011323.

= *Photinia serrulata* var. *aculeata* G.H.M.Lawr., Gentes Herbarum 8: 80. 1949. Type: CHINA. Taiwan: Seisiu, *E.H. Wilson 11061* (**lectotype, designated here**: US [barcode 00097504!]; isolectotype: A [barcode 00045608!]). Image of lectotype available from https://plants.jstor.org/stable/10.5555/al.ap.specimen.us00097504.

Distribution. China (Anhui, Fujian, Gansu, Guangdong, Guangxi, Guizhou, Hebei, Hubei, Hunan, Jiangsu, Jiangxi, Shaanxi, Sichuan, Taiwan, Yunnan, and Zhejiang), Indonesia, India, Japan, and Philippines.

Note C. In the protologue, the author cited only one collection of specimen, *R. Fortune A-30*, four sheets of this collection have been observed in P, one preserved well (barcode P [barcode P00781062]) was designated as lectotype here.

23b. *Photinia serratifolia* var. *ardisiifolia* (Hayata) H.Ohashi, J. Jap. Bot. 63(7): 234. 1988.

Common name: 紫金牛叶石楠 (Chinese name); pinyin (spelled as sounds in Chinese): zi jin niu ye shi nan

≡ *Photinia ardisiifolia* Hayata, Icon. Pl. Formosan. 5: 65. 1915. ≡ *Photinia serrulata* f. *ardisiifolia* (Hayata) H.L.Li, Lloydia 14(4): 234. 1951. ≡ *Photinia serrulata* var. *ardisiifolia* (Hayata) K.C.Kuan, Fl. Reipubl. Popularis Sin. 36: 224. 1974.

Type. CHINA. Taiwan: Taidong, Taito, Manchosha, 1 October 1906, *G. Nakahara s.n.* (**lectotype, designated here**: TAIF [accession no. 22366!]; isolectotype: IBSC [barcode 0285883!]).

Distribution. China (Taiwan).

23c. *Photinia serratifolia* var. *daphniphylloides* (Hayata) L.T.Lu, Acta Phytotax. Sin. 38(3): 277. 2000.

Common name: 宽叶石楠 (Chinese name); pinyin (spelled as sounds in Chinese): kuan ye shi nan

≡ *Photinia daphniphylloides* Hayata, Icon. Pl. Formosan. 7: 30. 1918. ≡ *Photinia serrulata* f. *daphniphylloides* (Hayata) H.L.Li, Lloydia 14(4): 234. 1951. ≡ *Pho-*

tinia serrulata var. *daphniphylloides* (Hayata) K.C.Kuan, Fl. Reipubl. Popularis Sin. 36: 222. 1974.

Type. China. Taiwan: Hualian, Tarako, Batagan-sya, 27 April 1917, *S. Sasaki s.n.* (**lectotype, designated here**: TAIF [accession no. 11810!]; isolectotype: TAIF [accession no. 11811!]).

Distribution. China (Taiwan).

23d. *Photinia serratifolia* var. *lasiopetala* (Hayata) H.Ohashi, J. Jap. Bot. 63(7): 234. 1988.

Common name: 毛瓣石楠 (Chinese name); pinyin (spelled as sounds in Chinese): mao ban shi nan

≡ *Photinia lasiopetala* Hayata, Icon. Pl. Formosan. 6: 17. 1916. ≡ *Photinia serrulata* var. *lasiopetala* (Hayata) K.C.Kuan, Fl. Reipubl. Popularis Sin. 36: 222. 1974. ≡ *Photinia serratifolia* var. *lasiopetala* (Hayata) H.Ohashi, J. Jap. Bot. 63(7): 234. 1988. ≡ *Pyrus lasiopetala* (Hayata) M.F.Fay & Christenh., Global Fl. 4: 110. 2018.

Type. China. Taiwan: Nantou, 1 April 1916, *B. Hayata s.n.* (holotype: TAIF [accession no. 11814!]; isotype: PH [barcode PH00067378!]).

Distribution. China (Taiwan).

24. *Photinia stenophylla* Hand.-Mazz., Symb. Sin. Pt. 7(3): 480, pl. 15, f.3. 1933.

Common name: 窄叶石楠 (Chinese name); pinyin (spelled as sounds in Chinese): zhai ye shi nan

≡ *Pyrus stenophylla* (Hand.-Mazz.) M.F.Fay & Christenh., Global Fl. 4: 122. 2018.

Type. China. Guizhou, Sandjio, *H. Handel-Mazzetti 10827* (lectotype, designated by Pathak et al. (2021: 41): WU [barcode 0059446!]). Sanhoa (= Sandu), Yao-ren-shan, *Y. Tsiang 6374* (syntypes: A [barcode 00026800!], NY [barcode 00436117!]). Image of lectotype available from https://plants.jstor.org/stable/10.5555/al.ap.specimen.wu0059446.

Distribution. China (Guangxi and Guizhou).

25. *Photinia taishunensis* G.H.Xia, L.H.Lou & S.H.Jin, Nordic J. Bot. 30(4): 439. 2012.

Common name: 泰顺石楠 (Chinese name); pinyin (spelled as sounds in Chinese): tai shun shi nan

Type. China. Zhejiang: Taishun County, Yangxi Village, *C.S. Ding 4116* (holotype: ZJFC [barcode 00030313!]; isotype: ZJFC [barcode 00030312!]).

Distribution. China (Zhejiang).

26. *Photinia tushanensis* T.T.Yu, Acta Phytotax. Sin. 8(3): 229. 1963.
Common name: 独山石楠 (Chinese name); pinyin (spelled as sounds in Chinese): du shan shi nan

≡ *Pyrus tushanensis* (T.T.Yu) M.F.Fay & Christenh., Global Fl. 4: 124. 2018.

Type. China. Guizhou, Dushan, *Libo Exped. 1296* (holotype: PE [barcode 00020611!]; isotype: PE [barcode 01498407!]).

Distribution. China (Guangxi and Guizhou).

27. *Photinia wardii* C.E.C.Fisch., Bull. Misc. Inform. Kew 1936(4): 281. 1936.
Common name: 长叶石楠 (Chinese name); pinyin (spelled as sounds in Chinese): chang ye shi nan

Type. India. Assam, Chibaon, Delei Valley, *F.K. Ward 8042* (holotype: K [barcode K000758348!]; isotypes: K [barcode K000758349!, K000758350!]). Image of holotype available from https://plants.jstor.org/stable/10.5555/al.ap.specimen.k000758348.

Distribution. India (Assam).

***Stranvaesia* Lindl., Edwards's Botanical Register 23: t. 1956. 1837.**
Common name: 红果树属 (Chinese name); pinyin (spelled as sounds in Chinese): hong guo shu shu

Type. Lectotype, designated by Liu et al. (2019: 686): *Crataegus glauca* Wall. ex G.Don (= *Stranvaesia nussia* (Buch.-Ham. ex D.Don) Decne.).

1. *Stranvaesia nussia* (Buch.-Ham. ex D.Don) Decne., Nouv. Arch. Mus. Hist. Nat. 10: 178. 1874.
Common name: 红果树 (Chinese name); pinyin (spelled as sounds in Chinese): hong guo shu

≡ *Pyrus nussia* Buch.-Ham. ex D.Don, Prodr. Fl. Nepal. 237. 1825. ≡ *Photinia nussia* (Buch.-Ham. ex D.Don) Kalkman, Blumea 21(2): 429. 1973.
= *Crataegus glauca* Wall. ex G.Don, Gen. Hist. 2: 598, descr. 1832. Type: Nepalia & Kumaon. 1829, *Wallich 673* (**lectotype, designated here**: K [barcode K000758343!, excluding the infructescence]; isolectotypes: G [barcode G00437202!, excluding the infructescence, G00437203!], GZU [barcode GZU000283039!], K [barcode K000758344!, K001111566!], L [barcode L0019509!], LE [barcode LE00013505!], M [barcode M-0213867!, M-0213868!, M-0213872!], P [barcode P02143111!], PH [barcode PH00028193!]). Image of lectotype available from https://plants.jstor.org/stable/10.5555/al.ap.specimen.k000758343.
= *Stranvaesia glaucescens* Lindl., Edwards's Bot. Reg. 23: t. 1956. 1837. nom. superfl.
= *Eriobotrya ambigua* Merr., Publ. Bur. Sci. Gov. Lab. 35: 19. 1906. ≡ *Stranvaesia ambigua* (Merr.) Nakai, J. Arnold Arbor. 5: 72. 1924. Type: PHILIPPINES.

Lamao River, Mt. Mariveles, Province of Bataan, Luzon, March 1905, *R. Meyer 2796* (lectotype, designated by Kalkman (1973: 429) 'holotype': K [barcode K000758366!]; isolectotypes: NY [barcode 00436214!], US [barcode 00097488!]). ibidem, March 1905, *H.N. Whitford 1155* (syntype: K [barcode K000758368!]). ibidem, March 1905, *H.N. Whitford 1168* (syntype: K [barcode K000758367!]). ibidem, June 1905, *H.N. Whitford 1307* (syntype: K [barcode K000758365!]). Image of lectotype available from https://plants.jstor.org/stable/10.5555/al.ap.specimen.k000758366.

= *Eriobotrya oblongifolia* Merr. & Rolfe, Philipp. J. Sci., C 3: 102. 1908. ≡ *Rhaphiolepis oblongifolia* (Merr. & Rolfe) B.B.Liu & J.Wen, Frontiers Pl. Sci. (Online journal) 10-1731: 11. 2020. Type: PHILIPPINES. Mindanao. Misamis: Mount Malindang, May 1906, *E.A. Mearns & W.J. Hutchinson 4680* (lectotype, designated by Liu et al. (2020b: 108): NY [barcode 00436215!]; isolectotype: US [barcode 00097490!]). Image of lectotype available from https://plants.jstor.org/stable/10.5555/al.ap.specimen.ny00436215.

= *Photinia harmandii* Cardot, Notul. Syst. (Paris) 3: 375. 1918. ≡ *Stranvaesia harmandii* (Cardot) Vidal, Notul. Syst. (Paris) 13: 301. 1948. Type: LAOS. Attopeu, 1877, *Harmand 1366* (**lectotype, designated here**: P [barcode P02143112!]; isolectotype: P [barcode P02143113!]). Image of lectotype available from https://plants.jstor.org/stable/10.5555/al.ap.specimen.p02143112.

Type. NEPAL. Nilcunt [Nilkantha, Shading District, Bagmati Zone, Madhyamanchal, Nepal; coordinates 27.91/84.94]. *Francis Buchanan-Hamilton s.n.* (lectotype, selected by Vidal (1965: 231), first step; second step, designated by Guo et al. (2020: 110): BM [barcode BM000522002!]). *Wallich 658* (syntype: L [barcode L0062739!, L0062740!], M [barcode M-0213869!]). *Wallich 658a* (syntype: M [barcode M-0210542!]). Image of lectotype available from https://plants.jstor.org/stable/10.5555/al.ap.specimen.bm000522002.

Distribution. China (Tibet and Yunnan), India, Laos, Myanmar, Nepal, Philippines, and Thailand.

1a. *Stranvaesia nussia* var. *nussia*

Common name: 红果树(原变种)(Chinese name)

Distribution. China (Tibet and Yunnan), India, Laos, Myanmar, Nepal, Philippines, and Thailand.

1b. *Stranvaesia nussia* var. *angustifolia* (Decne.) C.K.Schneid., Ill. Handb. Laubholzk. 1: 713. 1906.

Common name: 狭叶红果树(变种)(Chinese name); pinyin (spelled as sounds in Chinese): xia ye hong guo shu

≡ *Stranvaesia glaucescens* var. *angustifolia* Decne., Nouv. Arch. Mus. Hist. Nat. 10: 178. 1874.

Distribution. India (Mt. Khasia).

2. *Stranvaesia oblanceolata* (Rehder & E.H.Wilson) Stapf, Bot. Mag. 149: sub t. 9008. 1924.

Common name: 滇南红果树 (Chinese name); pinyin (spelled as sounds in Chinese): dian nan hong guo shu

≡ *Stranvaesia nussia* var. *oblanceolata* Rehder & E.H.Wilson, Pl. Wilson. (Sargent) 1: 193. 1913. ≡ *Pyrus oblanceolata* (Rehder & E.H.Wilson) M.F.Fay & Christenh., Global Fl. 4: 114. 2018.

Type. CHINA. Yunnan: forests around Szemao (Simao), alt. 1500–1600 m, *A. Henry 11615* (lectotype, selected by Vidal (1965: 232), first step; second step, designated by Guo et al. (2020: 110): US [barcode 00097547!]; isolectotype: A [barcode 00038562!]). ibidem, *A. Henry 11615a* (syntype: A [barcode 00038566!], K [barcode K000758307!], PE [barcode 01432740!]). ibidem, *A. Henry 11615b* (syntype: A [barcode 00038563!], K [barcode K000758306!], PE [barcode 01432741!], US [barcode 00429887!]). ibidem, *A. Henry 11615e* (syntype: A [barcode 00038564!], K [barcode K000758308!], PE [barcode 01432742!], US [barcode 00429888!]). ibidem, *A. Henry 11615f* (syntype: A [barcode 00038565!], K [barcode K000758306!]). Image of lectotype available from https://plants.jstor.org/stable/10.5555/al.ap.specimen.a00038562

Distribution. China (Yunnan), Laos, Myanmar, and Thailand.

3. *Stranvaesia lasiogyna* (Franch.) B.B.Liu, Molec. Phylogen. Evol. 189-107914: 11. 2023.

Common name: 倒卵叶红果树 (Chinese name); pinyin (spelled as sounds in Chinese): dao luan ye hong guo shu

≡ *Eriobotrya lasiogyna* Franch., Pl. Delavay. 225. 1890. ≡ *Photinia lasiogyna* (Franch.) C.K.Schneid., Repert. Spec. Nov. Regni Veg. 3: 153. 1906. ≡ *Pyrus avalon* M.F.Fay & Christenh., Global Fl. 4: 96. 2018. replacement name.

= *Stranvaesia glaucescens* var. *yunnanensis* Franch., Pl. Delavay. 226. 1890. Type: CHINA. Yunnan, in silvis supra Che-tong, prope Tapin-tze, May 18, 1885, *J.M. Delavay 1992* (lectotype, designated by Idrees and Shaw (2022: 31): P barcode P02143161!; isolectotype: P barcode P02143140!). Image of lectotype available from https://plants.jstor.org/stable/10.5555/al.ap.specimen.p02143161.

= *Photinia mairei* H.Lév., Bull. Acad. Int. Géogr. Bot. 17: 28. 1916. Type: CHINA. rochers-brousse des mont a Kiao-me-ti, May 1911–1913, *E.E. Maire s.n.* (lectotype, designated by Pathak et al. (2021: 41): E [barcode E00011316!]; isotype: A [barcode 00038571!]). Image of lectotype available from https://plants.jstor.org/stable/10.5555/al.ap.specimen.e00011316.

Type. CHINA. Yunnan, in silvis montanis ad fauces San-tchang-kiou supra Hokin, alt. 2300 m., 22 May 1884, *J.M. Delavay 732* (lectotype, designated by Pathak et al. (2021: 40): P [barcode P02143141!]; isolectotypes: P [barcode P02143142!], US [barcode 00097489!], image A [barcode 00026747! with plant material sam-

pled from P02143141!]). Image of lectotype available from https://plants.jstor.org/stable/10.5555/al.ap.specimen.p02143141.

Distribution. China (Fujian, Guangdong, Guangxi, Hunan, Jiangxi, Sichuan, Yunnan, and Zhejiang).

3a. *Stranvaesia lasiogyna* var. *lasiogyna*

Fig. 2D

Common name: 倒卵叶红果树(原变种)(Chinese name)

Distribution. China (Sichuan and Yunnan).

3b. *Stranvaesia lasiogyna* var. *glabrescens* (L.T.Lu & C.L.Li) B.B.Liu, Molec. Phylogen. Evol. 189-107914: 11. 2023.

Common name: 无毛倒卵叶红果树(变种)(Chinese name); pinyin (spelled as sounds in Chinese): wu mao dao luan ye hong guo shu

≡ *Photinia lasiogyna* var. *glabrescens* L.T.Lu & C.L.Li, Acta Phytotax. Sin. 38(3): 278. 2000.

Type. China. Jiangxi, Shangrao, 4 May 1972, *Jiangxi Exped. 1071* (holotype: PE [barcode 00336583!]; isotype: PE [barcode 00336582!]).

Distribution. China (Fujian, Guangdong, Guangxi, Hunan, Jiangxi, Sichuan, Yunnan, and Zhejiang).

***Weniomeles* B.B.Liu, Molec. Phylogen. Evol. 189-107914: 11. 2023.**

Common name: 椤木属 (Chinese name); pinyin (spelled as sounds in Chinese): luo mu shu

Type. *Weniomeles bodinieri* (H.Lév.) B.B.Liu ≡ *Photinia bodinieri* H.Lév.

Distribution. China (Anhui, Fujian, Guangdong, Guangxi, Guizhou, Hubei, Hunan, Jiangsu, Shaanxi, Sichuan, Yunnan, and Zhejiang), Indonesia, and Vietnam.

1. *Weniomeles bodinieri* (H.Lév.) B.B.Liu, Molec. Phylogen. Evol. 189-107914: 12. 2023.

Common name: 椤木 (Chinese name); pinyin (spelled as sounds in Chinese): luo mu

≡ *Photinia bodinieri* H.Lév., Repert. Spec. Nov. Regni Veg. 4: 334. 1907. ≡ *Pyrus eureka* M.F.Fay & Christenh., Global Fl. 4:103. 2018. replacement name. ≡ *Stranvaesia bodinieri* (H.Lév.) B.B.Liu & J.Wen, J. Syst. Evol. 57(6): 686. 2019. ≡ *Stranvaesia bodinieri* (H.Lév.) Long Y.Wang, W.B.Liao & W.Guo, Phytotaxa 447(2): 110. 2020. later homonym.

= *Photinia davidsoniae* Rehder & E.H.Wilson, Pl. Wilson. 1: 185. 1912. ≡ *Pyrus davidsoniae* (Rehder & E.H.Wilson) M.F.Fay & Christenh., Global Fl. 4:101. 2018. Type:

CHINA, Western Hupeh (Hubei): near Ichang (Yichang), alt. 300–600 m., April 1907, *E.H. Wilson 685* (lectotype, selected by Vidal (1968), first step "type"; second step, designated by Liu et al. (2019: 687): A [barcode 00038567!] excluding the fruits and seeds in the packet; isolectotypes: BM [barcode BM000602130!], E [barcode E00011306! excluding the fruiting branch), GH [barcode 00045598! excluding the fruiting branch], HBG [barcode HBG511078! excluding the fruiting branch], US [barcode 00097494! excluding the fruiting branch]). ibidem, *E.H. Wilson 685* (paratype: A [barcode 00038567, only the fruits and seeds in the packet, 00045599!], E [barcode E00011306, excl. the flowering branch!], GH [barcode 00045598, excl. the flowering branch!], HBG [barcode HBG511078, excl. the flowering branch!], US [barcode 00097494, excl. the flowering branch!]). CHINA, Hubei: south-west of Ichang, alt. 300 m, November 1907, *E.H. Wilson 484* (paratypes: BM [barcode BM000946991!], HBG [barcode HBG511080!]). mountains south of Ichang, May 1900, *E.H. Wilson 462* (paratypes: HBG [barcode HBG511079!], P [barcode P02143162!]). Image of lectotype available from https://plants.jstor.org/stable/10.5555/al.ap.specimen.a00038567.

= *Hiptage esquirolii* H.Lév., Repert. Spec. Nov. Regni Veg. 10:372. 1912. Type: CHINA, Kouy-Tchéou (now as Guizhou): Choui-Teou, route de Tin-Pan-Lo-Fou, alt. 900 m, 4 May 1900, *J Esquirol 2097* (lectotype, designated by Liu et al. (2019: 687): E [barcode E00011307!]; isolectotypes: A [barcode 00015103!, 00045102!]). Image of lectotype available from https://plants.jstor.org/stable/10.5555/al.ap.specimen.e00011307.

Type. CHINA, Kouy-Tchéou (now Guizhou): environs de Kouy-Yang, mont. du Collège, ca et là autour des villages, 18 May 1898, *E. Bodinier 2256* (lectotype, designated by Liu et al. (2019: 686): P [barcode P02143207!]; isolectotypes: A [barcode 00045584!], E [barcode E00010998!], P [barcode P02143208!, P02143209!]). Image of lectotype available from https://plants.jstor.org/stable/10.5555/al.ap.specimen.p02143207.

Distribution. China (Anhui, Fujian, Guangdong, Guangxi, Guizhou, Hubei, Hunan, Jiangsu, Shaanxi, Sichuan, Yunnan, and Zhejiang), Indonesia, and Vietnam.

1a. *Weniomeles bodinieri* var. *bodinieri*

Fig. 2E, 10

Common name: 椤木(原变种)(Chinese name)

Distribution. China (Anhui, Fujian, Guangdong, Guangxi, Guizhou, Hubei, Hunan, Jiangsu, Shaanxi, Sichuan, Yunnan, and Zhejiang), Indonesia, and Vietnam.

1b. *Weniomeles bodinieri* var. *longifolia* (Cardot) B.B.Liu, Molec. Phylogen. Evol. 189-107914: 13. 2023.

Common name: 长叶椤木 (Chinese name); pinyin (spelled as sounds in Chinese): chang ye luo mu

≡ *Photinia bodinieri* H.Lév. var. *longifolia* Cardot, Notul. Syst. (Paris) 3: 374. 1918. ≡ *Stranvaesia bodinieri* var. *longifolia* (Cardot) B.B.Liu & J.Wen, J. Syst. Evol. 57(6): 687. 2019.

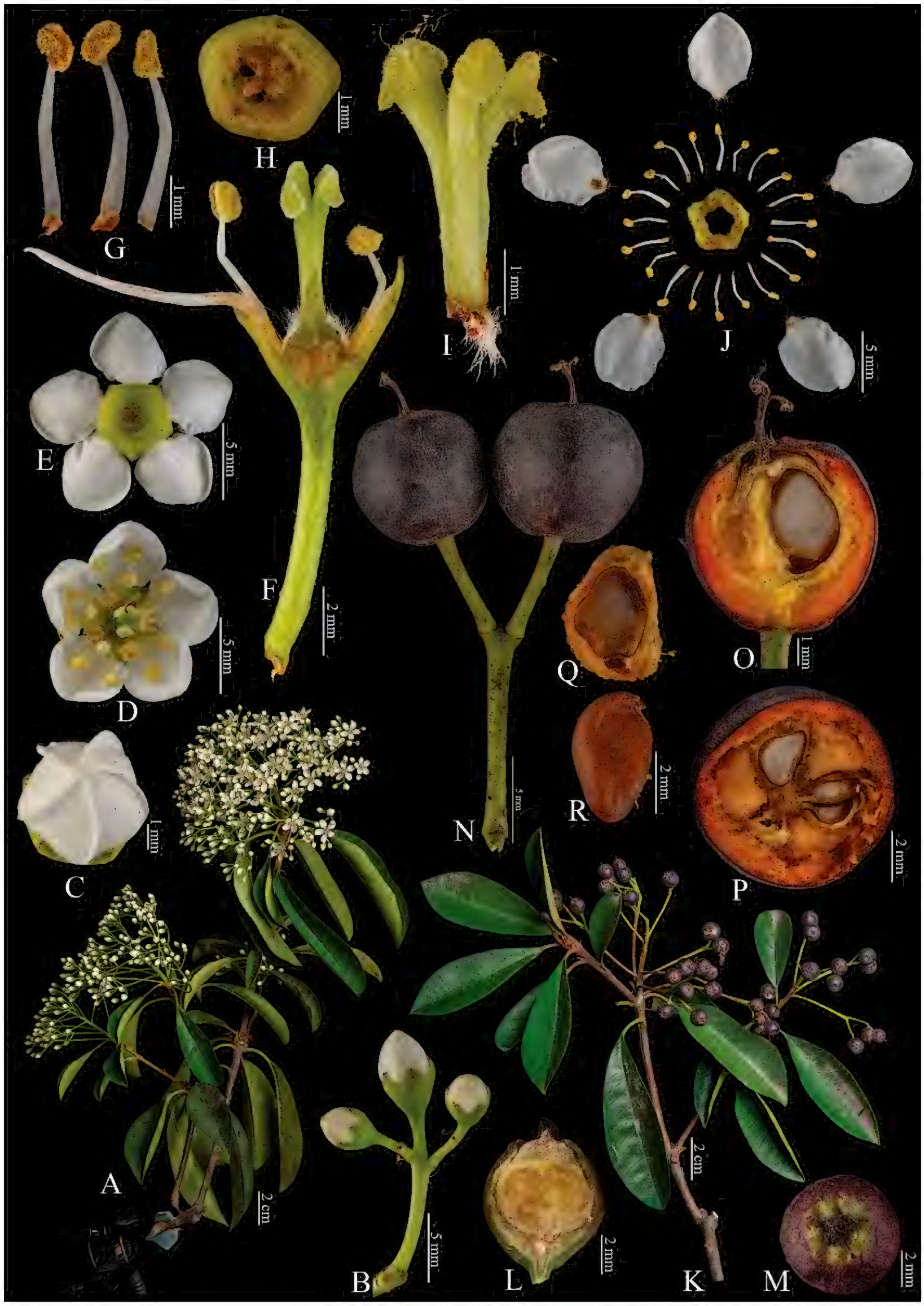


Figure 10. Comprehensive structural anatomy of *Weniomeles bodinieri*. **A** branch of the inflorescence **B** flowers **C, D** comparative top view of a single flower in both unopened and opened states **E** bottom perspective of an individual flower **F** longitudinal section through the ovary **G** stamens **H** cross-section through the ovary **I** detailed view of the pistil **J** dissected flower, illustrating internal structure **K** branch of the infructescence **L** cross-section of a young fruit **M** top view of a developing fruit **N** mature fruits **O** longitudinal-section through a mature fruit **P** cross-section through a mature fruit **Q** cross-section through a mature seed **R** a fully matured seed. The inflorescence branches were collected on June 14, 2022, and the infructescence branches were gathered on December 15, 2023, by Bin-Jie Ge at the Chenshan Botanical Garden, Shanghai. Additionally, Bin-Jie Ge dissected and photographed all the samples.

Type. CHINA, Kouei Tchéou (now as Guizhou Province): grande route Kouei Tchéou au Kuangsi (Guangxi Province), Kout'ong (now as Gudong Xiang, Pingtang County), 22 May 1899, *Beauvais J. 175* (lectotype, designated by Liu et al. (2019: 687): P [barcode P02143211!]; isolectotype: P [barcode P02143210!]). Image of lectotype available from https://plants.jstor.org/stable/10.5555/al.ap.specimen.p02143211.

Distribution. China (Guizhou).

1c. *Weniomeles bodinieri* var. *ambigua* (Cardot) B.B.Liu, Molec. Phylogen. Evol. 189-107914: 13. 2023.

Common name: 尖瓣椤木 (Chinese name); pinyin (spelled as sounds in Chinese): jian ban luo mu

≡ *Photinia davidsoniae* var. *ambigua* Cardot, Notul. Syst. (Paris) 3: 374. 1918.

Type. CHINA, Su-Tchuen (Sichuan): Eul Se Yug, vallée du Yalory, alt. 2000 m, 5 May 1911, *Legendre 834* (lectotype, designated by Jin et al. (2023: 13): P [barcode P02143164!]; isolectotype: P [barcode P02143165!). Image of lectotype available from https://plants.jstor.org/stable/10.5555/al.ap.specimen.p02143164.

Distribution. China (Sichuan).

1d. *Weniomeles bodinieri* var. *pungens* (Cardot) B.B.Liu, Molec. Phylogen. Evol. 189-107914: 13. 2023.

Common name: 尖叶椤木 (Chinese name); pinyin (spelled as sounds in Chinese): jian ye luo mu

≡ *Photinia davidsoniae* Rehder & E.H.Wilson var. *pungens* Cardot, Notul. Syst. (Paris) 3: 374. 1918.

Type. CHINA, Hubei: Ichang, *A. Henry 7174* (holotype: P [barcode P02143163!). Image of holotype available from https://plants.jstor.org/stable/10.5555/al.ap.specimen.p02143163.

Distribution. China (Hubei).

2. *Weniomeles atropurpurea* (P.L.Chiu ex Z.H.Chen & X.F.Jin) B.B.Liu, comb. nov.

urn:lsid:ipni.org:names:77342734-1

Common name: 黑果椤木 (Chinese name); pinyin (spelled as sounds in Chinese): hei guo luo mu

≡ *Photinia atropurpurea* P.L.Chiu ex Z.H.Chen & X.F.Jin, J. Hangzhou Univ., Nat. Sci. Ed. 20(4): 393. 2021.

Type. CHINA, Zhejiang: Taishun, Zuoxi, Lishuqiu, alt. 400 m, 3 May 2020, *Z.H. Chen, Z.P. Lei & W.Y. Xie TS20050316* (holotype: ZM; isotype: ZM).

Distribution. China (Zhejiang).

Conclusion

In summary, our study addresses the long-standing deficiency of the comprehensive phylogenetic backbone in the apple tribe Maleae, primarily stemming from limited taxon and marker sampling in prior research efforts. Our phylogenomic investigations conclusively identified three major clades within the tribe. Integrating evidence from nuclear phylogeny, morphology, and ploidy estimation, we present an updated infra-tribal taxonomic system, introducing subtribe Malinae Reveal, subtribe Lindleyinae Reveal, and subtribe Vauqueliniinae B.B.Liu (subtr. nov.). Notably, our plastid phylogenetic analysis underscored the monophyly of most genera, albeit with exceptions such as *Amelanchier*, *Malus*, *Sorbus* s.l., and *Stranvaesia*. Furthermore, we contribute a comprehensive taxonomic synopsis of *Photinia* and its morphological counterparts in the Old World, recognizing and delineating 27 species along with ten varieties within *Photinia*, three species and two varieties within *Stranvaesia*, and two species paired with three varieties within *Weniomeles*. Additionally, our study makes a valuable contribution by lectotypifying 12 names and making two new combinations, thereby aiding in clarifying nomenclatural ambiguities.

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Additional information

Conflict of interest

The authors have declared that no competing interests exist.

Ethical statement

No ethical statement was reported.

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Author contributions

B.B.L conceptualized and led the project, with collaborative supervision from G.N.L and S.H.J. The data assembly and phylogenomic analysis were carried out by H.W, X.Y.L, and Y.J. C.X was responsible for conducting the experimental work. The initial draft of the

manuscript was skillfully prepared by H.W, X.Y.L, Y.J, D.K.M, and Z.T.J. B.J.G examined and detailed the fine structure of the species represented in the study. T.W contributed by providing fresh samples essential for analyzing the fine structure. B.L offered valuable insights and feedback on the Chinese names proposed in the research. All the authors approved the final manuscript.

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Data availability

All of the data that support the findings of this study are available in the main text or Supplementary Information.

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Supplementary material 1

Phylogenetic tree of the apple tribe Maleae extimated through maximum likelihood analysis using IQ-TREE2

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Data type: pdf

Explanation note: Phylogenetic tree of the apple tribe Maleae extimated through maximum likelihood analysis using IQ-TREE2, based on the whole plastome dataset. The numbers displayed above each branch represent the SH-aLRT support values and Ultrafast Bootstrap support percentages, respectively.

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Link: https://doi.org/10.3897/phytokeys.242.117481.suppl1

Supplementary material 2

Phylogenetic tree of the apple tribe Maleae extimated through maximum likelihood analysis using RAxML

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Data type: pdf

Explanation note: Phylogenetic tree of the apple tribe Maleae extimated through maximum likelihood analysis using RAxML, based on the whole plastome dataset. The numbers displayed above each branch represent the Bootstrap support value.

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